Dissertation on

ROLE OF ZONULAR ASSESSMENT BY ULTRASOUND BIOMICROSCOPY BEFORE CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME TOWARDS ENSURING SATISFACTORY PCIOL IMPLANTATION.

Submitted in partial fulfillment of requirements of

MASTER OF SURGERY DEGREE

BRANCH – III – (OPHTHALMOLOGY)

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CHENNAI

2018

CERTIFICATE

This is to certify that this dissertation entitled **"ROLE OF ZONULAR ASSESSMENT BY ULTRASOUND BIOMICROSCOPY BEFORE CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME TOWARDS ENSURING SATISFACTORY PCIOL IMPLANTATION."** is a bonafide record of research work done by **Dr. S. SANGEETHA,** Post Graduate Resident in Department of Ophthalmology, Madurai Medical College, Madurai.

She has submitted this in partial fulfillment of the regulations laid down by The Tamil Nadu Dr. M.G.R. Medical University, for the award of Master of Surgery Degree Branch III (Ophthalmology), under our guidance and supervision during the academic years 2015-2018.

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This is to certify that this dissertation entitled **"ROLE OF ZONULAR ASSESSMENT BY ULTRASOUND BIOMICROSCOPY BEFORE CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME TOWARDS ENSURING SATISFACTORY PCIOL IMPLANTATION."** is a bonafide record of research work done by **Dr. S. SANGEETHA,** Post Graduate Resident in Department of Ophthalmology, Madurai Medical College, Madurai.

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DECLARATION

I, **Dr. S. SANGEETHA**, hereby solemnly declare that, this dissertation titled **"ROLE OF ZONULAR ASSESSMENT BY ULTRASOUND BIOMICROSCOPY BEFORE CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME TOWARDS ENSURING SATISFACTORY PCIOL IMPLANTATION."** was done by me.

I also declare that this bonafide work / a part of this work was not submitted by me / anyone else, for any award, for Degree / Diploma to any other University / Board either in India / abroad. This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfilment of the rules and regulations for the award of Master of Surgery degree Branch -III (Ophthalmology) to be held in May 2018.

Place: Madurai **(Dr. S. SANGEETHA)**

Date:

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CONTENT

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PART I

INTRODUCTION

Pseudoexfoliation syndrome is an age related, generalized disorder of the extracellular matrix characterized by the excessive production of elastic micro fibrils and their aggregation into mature Pseudoexfoliation fibrils.

Pseudoexfoliation has the property of altering the biochemical structure of the tissues in which it is deposited. Poor pupillary dilation, loss of zonular tensile strength, obstruction of the angles, blood aqueous barrier defect is commonly encountered.

The development of open angle glaucoma, closed angle glaucoma and cataract with zonular instability are more with Pseudoexfoliation syndrome.

Ultrasound biomicroscopy provides high resolution imaging of ocular structures anterior to the pars plana region of the eye. UBM is a non-invasive recent technique for assessing the ocular anatomy at near microscopic resolution by using high frequency ultrasound transducer.

In cataract surgery complications are often encountered with Pseudoexfoliation syndrome.

So before cataract surgery, Morphology of zonules with Pseudoexfoliation deposition can be studied in detail by using UBM. This helps in the prediction of operative complications during cataract surgery and helps in taking necessary actions. Example, capillary tension ring to prevent the zonular instability.

EPIDEMIOLOGY

XFS it is more common in older age groups occurring in late 60's & early 70's. Its prevalence increases dramatically with age.

According to Framingham study the prevalence of exfoliation syndrome was 0.6 percentage in patients younger than 65 years of age, 2.6 percentages in patients 65 to 74 years of age and 5.0 percentages in patients 75 to 85 years of age.

This condition involves both the genders. It is less common in men than in women, but the combination of Pseudoexfoliation syndrome and glaucoma occurs equally in both genders.

The incidence of cataract formation and glaucoma are relatively high in XFS.

The presentation can be unilateral or bilateral. 25 to 50 percentages of the cases of pseudo exfoliation syndrome are unilaterally at detection, but approximately 15 to 40 percentages of these cases develop pseudo exfoliation syndrome bilaterally over 5 to 10 years.

On simple microscopic examination, the exfoliation material is seen as a fibrillar protein in an irregular meshwork. Pseudo exfoliation syndrome is seen to be widely distributed in the ocular tissues. The rigidity of the lamina cribrosa may be affected.

Initially it was believed that all of the material came from the epithelium of lens and its capsule. Later it was found that it has a multifocal origin like ciliary epithelium, iris and conjunctiva and also in ocular and orbital blood vessels and skin of the eyelid.

The etiology of XFS remains unidentified; the disease seems to depend on genetic factors around the **Lysyl oxidase like 1** gene.

In recent times, a polymorphism in exon 1 of the LOXL1 gene has been highly associated with pseudo exfoliative syndrome found in Sweden and Iceland where the prevalence of exfoliative syndrome is very high.

The similar polymorphisms have been confirmed in populations in other parts of Europe, India, the United States, Australia, and Japan.

Lysyl oxidase-like 1 LOXL1, a key cross-linking matrix enzyme normally required for proper elastic fibers formation and stabilization.

It is encoded by the LOXL1 gene. In PEX tissues, expression of Lysyl oxidase-like 1 LOXL1 was found to be markedly dysregulated.

This may adversely affect elastin metabolism and lead to elastic alteration in tissues.

Matrix metalloproteinases inhibitors of has been found to be upregulated and actual matrix metalloproteins has been found to be downregulated in the aqueous humor with pseudo exfoliative syndrome compared to eyes without.

Exfoliation syndrome is not related with any known systemic disorder. However, a retrospective study proposes that patients with exfoliative syndrome have a greater risk of acute cerebrovascular diseases and chronic cerebral conditions like Alzheimer disease than with Primary Open Angle Glaucoma

Also a study showed increased level of plasma homocysteine in pseudo exfoliative patients compared with normal-tension glaucoma. Higher levels of plasma homocysteine have been linked with increased risk of cardiovascular disease.

CLINICAL PRESENTATION OF PSEUDOEXFOLIATION

The exfoliative material is formed by the epithelium of lens, iris pigments and ciliary body. Deposition can occur in many intra & extraocular tissues, including conjunctiva, skin, extraocular muscles and connective tissues.

Pseudo exfoliative material found in the walls of vessels. Extraocular sites are involved mainly renal, hepatic, pulmonary systems, other than ocular muscle, and in connective tissues.

White flakes of the pseudo exfoliative material are deposited on the corneal endothelium, anterior and posterior iris, pupillary margin, trabecular meshwork, zonules, and ciliary processes as well as the anterior hyaloid face of the vitreous in aphakic eyes.

IRIS & PUPIL

Histopathologically, PXF material accumulates in iris, reducing stromal elasticity and causing iridopathy.

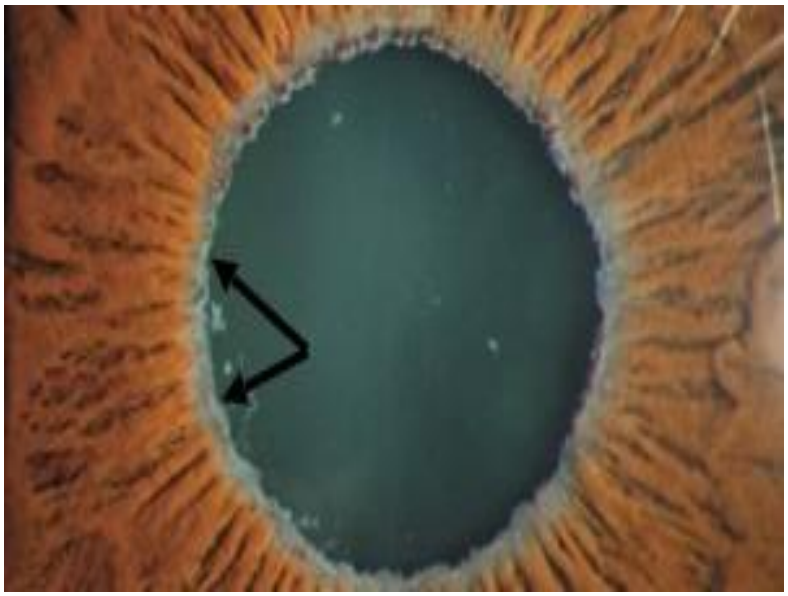
The iris pigment epithelium demonstrates a serrated appearance in histologic sections, showing PXF material bridging folds of posterior iris surface.

There is a relative anterior chamber hypoxia due to reduced iris capillary flow, which has been postulated to lead to atrophic changes in the iris sphincter and dilator muscles.

Finally, the disrupted blood aqueous barrier can lead to intraocular bleeding with minimal manipulation of iris tissues.

Involvement of iris can be evidenced by poor dilatation, exfoliative deposits at the margin, transillumination defects and around iris vessels which can be demonstrated on electron microscopy.

Poor pupillary dilatation occurs due to Pseudo exfoliative material infiltrating the iris stroma. Moreover it also causes mechanical restriction for dilatation.

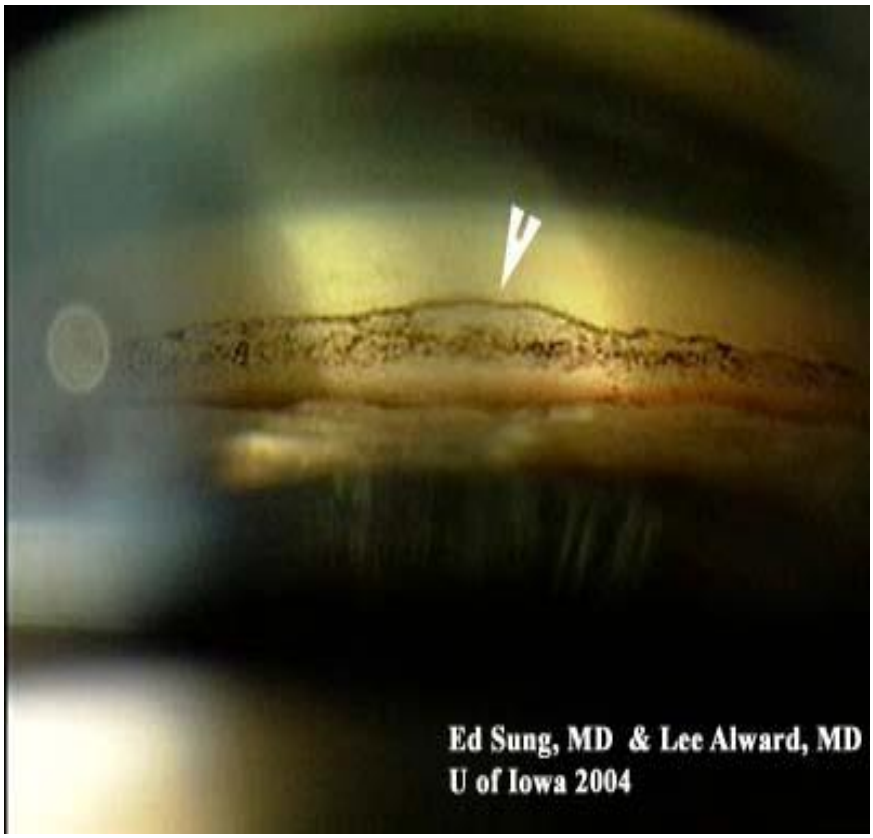


The uneven, moth eaten pattern of transillumination is one of the significant signs of exfoliation syndrome.

The pigment from the iris is left in the trabecular meshwork, in the anterior iris, and to some extent on the corneal endothelium.

PXF may also causes breakdown of the blood aqueous barrier. The angle pigmentation can be moderate to severe in amount and to some extent patchy in distribution.

A wavy pigmented line may be seen anterior to or on Schwalbe's line called the Sampaolesi's line. Pigments may be released when the pupil is dilated

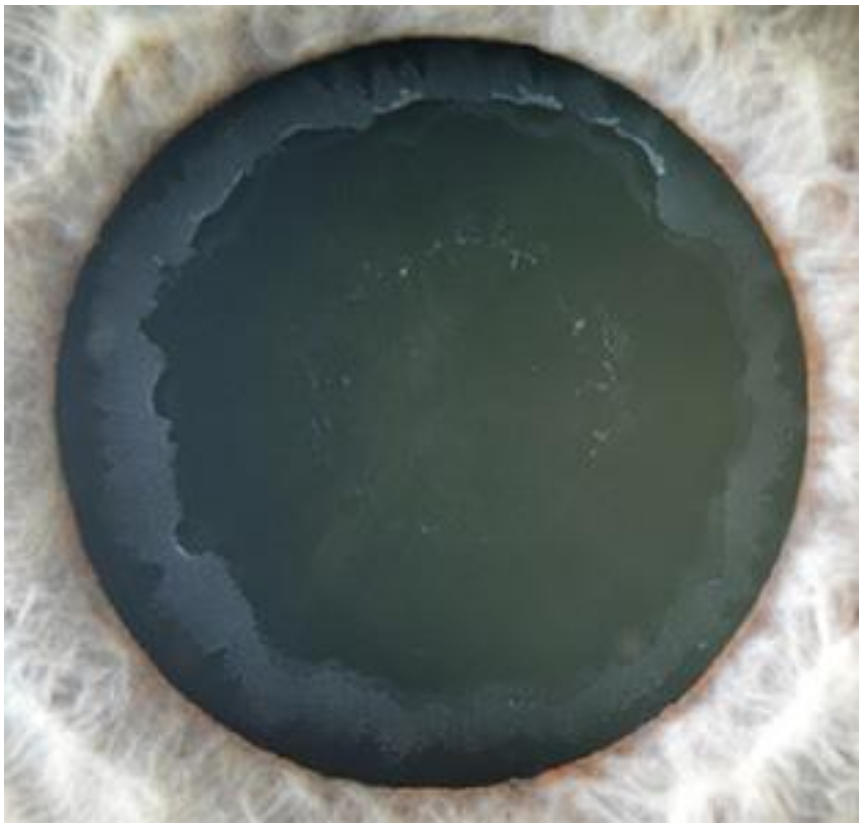


ANTERIOR LENS CAPSULE

Clinical presentation of exfoliation syndrome on an anterior lens capsule frequently demonstrates a **Three Ring Sign**, which consists of a central zone of visible exfoliation material, middle clear zone and a peripheral cloudy ring.

Central zone is translucent disc surrounded by a clear middle zone, which in turn is bounded by a granular grey white ring with scalloped edges.

This is best valued when the lens is examined with the slit lamp after pupillary dilation; if the pupil is poorly dilated numerous cases can be missed because the ring sign may not be observable within a small pupil



Central and peripheral zones can be completely separate or can be combined by bridges of exfoliative material. It has been suggested that the movement of the central iris polishes the lens and produces the clear zone.

In certain cases, the central disc is not present. The peripheral zones have radial striations and raised edges.

Increased prevalence of lens opacification, predominantly nuclear sclerosis associated with PXF.

If exfoliative material is partially seen on the lens capsule, it most frequently begins in the superonasal quadrant.

PXF can present as asymmetrically with observable clinical changes unilaterally, and microscopic changes in the anterior segment of the fellow eye have been identified.

In immunohistochemically studies, degenerative changes are identified in the trabecular meshwork, iris pigment epithelium and dilator muscle.

Within 5 to 10 years of diagnosis, approximately 15 percentages to 50 percentages of patients can progress bilaterally.

IOP

It can also associate with secondary open angle glaucoma, world widely. The trabecular meshwork obstruction by this pseudo exfoliative material causes significant elevation of the intraocular pressure.

Recent study has showed that this syndrome is caused by a stress induced elastic micro fibrillopathy.

CORNEAL ENDOTHELIUM

Patients with PXF have a more susceptible corneal endothelium due to a reduced density of endothelial cells and pleomorphic changes, which can be seen on specular microscopy.

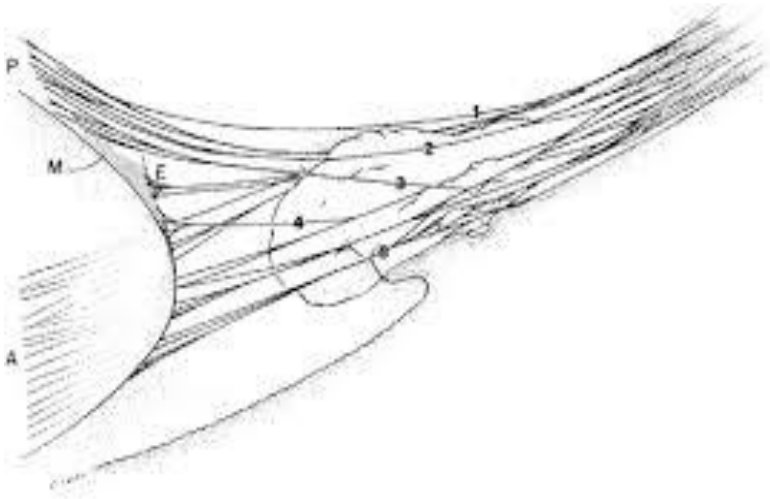
Histologically, PXF deposits and phagocytosed melanin are found on the posterior cornea and Descemet membrane.

Although rare, corneal decompensation may lead to corneal transplantation. Therefore, patients with PXF may get benefited from measures that protect the corneal endothelium, similar to patients with Fuchs endothelial dystrophy.

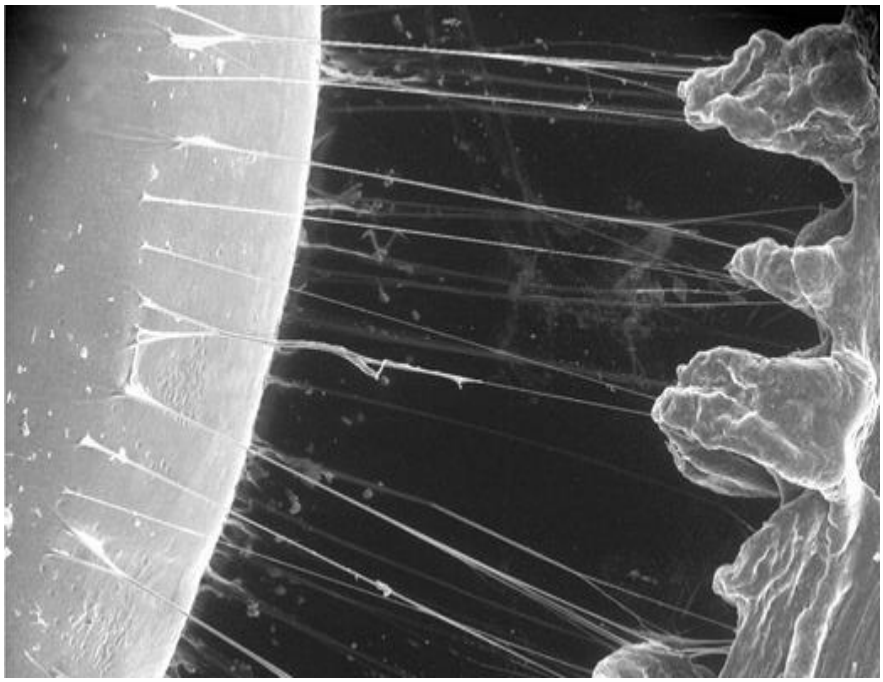
Preoperatively, patients can also be assessed by examining guttata at the slit lamp. In PXF, guttata are more diffuse, in contrast to central guttata seen in Fuchs endothelial dystrophy. Specular microscopy of cornea is useful in documenting preoperative corneal endothelial cell counts.

ZONULES

The zonules of Zinn named after Johann Gottfried Zinn is a ring of fibrous strands connecting ciliary body with crystalline lens of the eye. The other names for zonules are Zinn's membrane, ciliary zonules, and the suspensory ligaments of the lens.



The zonules of Zinn are divided into two different layers. A thin layer, lining the hyaloid fossa, and a thicker layer, is a collection of zonular fibers. Both together, the fibers are named as the suspensory ligament of the lens. The zonules diameters are about 1 to 2 micro meter.



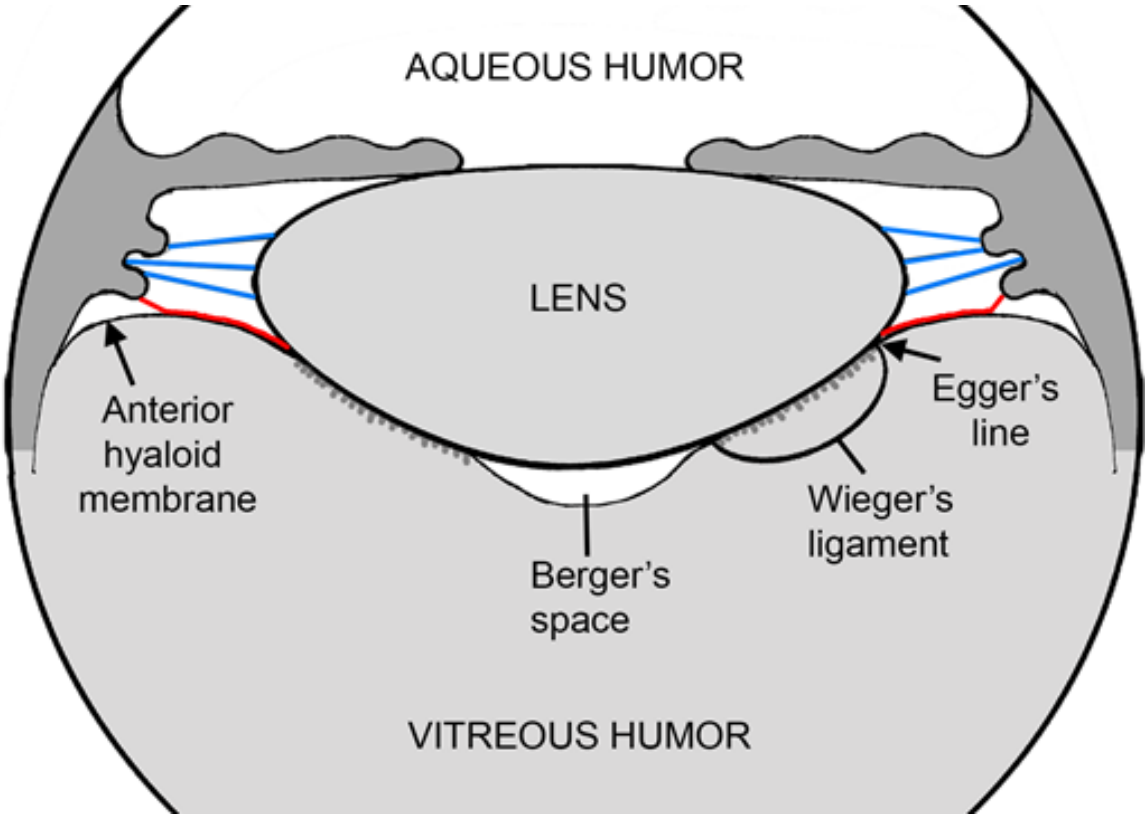
Zonules arise from pars plana of ciliary body and runs forwards to the lateral surface of ciliary process. Zonules are attached to the 2 millimeter anterior to the equator and 1millimeter posterior to lens capsule.

The zonules are made by a connective tissue protein, fibrillin. Mutations in the gene encoding fibrillin lead to an increased risk of lens dislocation in Marfan syndrome.

The zonules of Zinn are hard to visualize in a slit lamp, but may be seen with exceptional pupillary dilatation, or rarely in a coloboma of the iris or in a subluxation of the lens

The quantity of zonules present in a person appears to decrease with aging. The zonules are inserted around the lens equator, both anteriorly and posteriorly.

Zonules have three different types of fibres primary, secondary and tension fibres. Primary zonular fibres attaches with the lens capsule. Secondary zonular fibres connect the primary zonules with each other. A tension zonular fibre attaches the primary fibres to the basement membrane of ciliary processes.



Schlo¨tzer-Schrehardt & Naumann 1994, Kivela et al. 1997, Schlo tzerSchrehardt & Naumann 2006, Deposits of pseudo exfoliation material causes coating and thickening the zonules, giving a granulated and patchy in appearance.

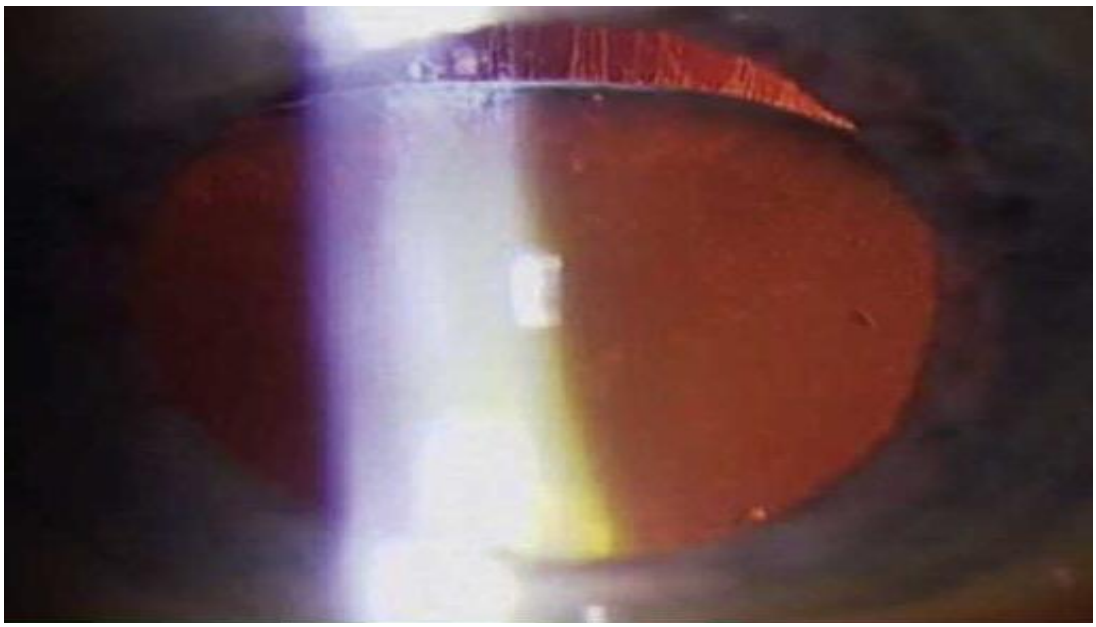
Ritch et al in 2007 assessed the zonular appearance by using an ultrasound biomicroscopy grading score in which patients with pseudo exfoliation syndrome had showed correlation of the ultrasound biomicroscopy images with clinical aspects determined by the slit lamp biomicroscopy.

Weakness of the zonules can be attributed to deposition of pseudo exfoliative materials on zonular fibers and the ciliary processes. Proteolytic disintegration of zonules can lead to the spontaneous fragmentation.

Slit lamp examination shows signs such as phacodonesis, lenticular subluxation, iridodonesis, and lenticular dislocation gives clue about the zonular abnormalities.

Other well known risk factors for zonular instability are such as Trauma, genetic syndromes like Marfan, advanced age.

In eyes with retinopathy of prematurity and those with 4 plus brunescent nuclei zonular instability can be suspected as said by David F. Chang, MD. High myopes, with axial length greater than 26 millimeters, can have weak zonules, said Mark Packer, MD.



Eye surgeries like radial keratotomy or glaucoma surgery may cause a shallow or flat anterior chamber, by perforation or excessive filtration, and thereby creates a stress on the zonular apparatus, Dr. Packer explained.

Vitrectomy may also cause stretching and weakening of zonules, by Dr. Nichamin.

Phacodonesis, due to zonular instability can be graded as follows.

Grade 1, Phacodonesis could be found only by careful slit-lamp examination, without Iridodonesis or visible zonular dialysis

Grade 2, Phacodonesis could be easily noticed by a slit-lamp examination, with or without Iridodonesis, no zonular dialysis noticed

Grade 3, Phacodonesis could be easily noticed by a slit-lamp examination, accompanied by Iridodonesis and zonular dialysis and even lens dislocation.

The signs of increased lenticular mobility can imply a zonular defect. Because of difficulty in visualizing the zonules through the intact iris, the nature and extent of this defect is frequently uncertain.

Before doing cataract surgery, it is important to know whether there is any zonular weakness. Meticulous examination should be done to assess for subtle lens subluxation, zonular dehiscence or iridophacodonesis.

DIFFERENTIAL DIAGNOSIS FOR PSEUDOEXFOLIATION

Important differential diagnoses are pigmentary glaucoma, amyloidosis, and true exfoliation

TRUE EXFOLIATION

True exfoliation or lamellar delamination of the lens capsule is a rare disorder in which an anterior layer of the lens capsule delaminates and appears as a thin, fluttering membrane in the anterior chamber.

The pathogenesis of this disorder is relatively unknown, but intense infrared radiation has been thought to be the main causative factor.

It is more common in glassblowers who were exposed to intensely hot, open fires.

With light microscopy, scanning and transmission electron microscopy it has been demonstrated a lamellar separation of the anterior portion of the lens capsule in true exfoliation, thus confirming the diagnosis.

PIGMENTARY DISPERSION SYNDROME

Pigment dispersion syndrome is a type of an autosomal dominant disorder. It has been characterized by excessive liberation of pigment in the anterior segment of the eye.

The characteristic features are in pigment deposition on the posterior surface of the cornea, trabecular meshwork, and iris transillumination defects.

This causes reduction in the aqueous outflow and leads to pressure elevation.

Pigmentary glaucoma and Pigment Dispersion Syndrome occur due to rubbing of the posterior iris against the lens zonules.

The disease is more common in males, and typically presents in 30 to 40 years of age.

In pigment dispersion syndrome, there is often a vertical pigment deposition on the corneal endothelium, named as Krukenberg's spindle or Zentmeyer line.

Both pigmentary and pseudo exfoliation syndrome can have Transillumination defects in iris.

In pigment dispersion syndrome, the defects are in mid peripheral iris, whereas in pseudo exfoliation the defects are closer to the pupillary margin.

The iris in PDS and pigmentary glaucoma tends to have a periphery concave configuration, which is another unique feature.

AMYLOIDOSIS

Amyloidosis is a spectrum of disorders characterized by the abnormal deposition of insoluble protein.

The amyloid proteins are abnormal protein folding, are deposited as insoluble fibrils.

It can be detected on electron microscopy as non-branching deposition, rigid, and mostly extracellular.

Binding of the Congo red dye and apple green birefringence on polarized light microscopy are useful in diagnosis.

Many ocular signs and symptoms can occur by amyloidosis including lid malposition's, displacement of globe, abnormal motility, diplopia, recurrent subconjunctival hemorrhage, conjunctival mass lesion,

corneal opacity, increased intraocular pressure , vitreous opacities and abnormal fundus appearance.

Published reports of amyloidosis in eye include involvement of the iris and pupillary margin, trabecular meshwork, and the anterior surface of the lens.

Involvement of the trabecular meshwork and uvea may present as glaucoma with elevated IOP reported as high as 42 millimeter of Hg.

Pathogenesis is thought to involve amyloid protein in the aqueous that clogs and directly infiltrates the trabecular meshwork.

In systemic amyloidosis, iris and anterior chamber involvement may present in association with vitreoretinal involvement

A scalloped configuration of the iris margin signifies amyloid deposition in the iris stroma. Amyloid deposition appears as whitish, flocculent debris in the aqueous, on the lens capsule or on the iris surface.

ULTRASOUND BIOMICROSCOPY

The first application of diagnostic ultrasound in the eye was reported in 1956 by Mundt and Hughes. Later, Oksala and Lehtinen of Finland described first clinical examinations with a handheld A-mode transducer.

At that time however the availability of transducers were typically unfocused and had frequencies of only around 4 MHz, which was not useful for many ophthalmic goals.

In the year 1950, Baum and Greenwood were the first to utilize B mode scanning for ocular examinations.

Pavlin et al the one who first introduced a 50 MHz probe using a PVF transducer and a scanner.

This device provides good quality images of the anterior segment of eye. They named this device as an **ULTRASOUND BIOMICROSCOPE.**

It is high resolution ultrasound imaging that uses higher frequencies in the range of 50 to 100Hz for visualization of anterior segment of eye.

Due to higher frequency it has good resolution but with a lesser penetration than conventional B scan which has a frequency range of around 10Hz.

The penetration of UBM is roughly around 4 to 5 millimeter and the structures visualized.

Visualization includes cornea, conjunctiva, sclera, anterior chamber, iris, ciliary body, and lens up to its posterior capsule.

UBM allows dynamic capture of anterior segment responses to accommodation, to dark or light stimulation as well.

INSTRUMENTATION

Consists of an ultrasound transducer, a signal processor and an articulated arm to steady the scanning head and provide precise motion control.

The system is connected to a computer for synchronization & analysis of data. Commercially probes are available with frequencies ranging from 30 to 50 Hz.

UBM TECHNIQUE

It uses the immersion technique with fluid. A silicone eyecup serves to hold the fluid and acts as a coupling medium.

The procedure is done in lying down position after application of a local anesthetic drops.

The eyecup is used to separate the eyelids and it is filled with 1percentage methylcellulose or normal saline.

The transducer is immersed in the solution and placed directly over the part to be scanned perpendicular to it.

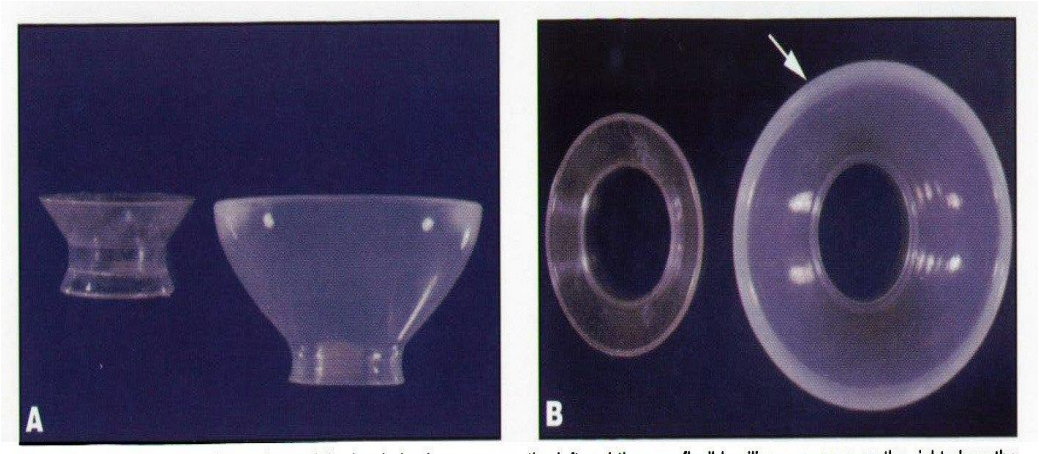


Figure 1. (A) Side and **(B)** top views of the hard plastic eyecup on the left and the new flexible silicone eyecup on the right show the new eyecup has a greater height and an elliptic flare (arrow) section.

The arm is rotated and turned in horizontal meridian to scan any part needed.

In this way the cornea and all the anterior segment structures can be visualized at near light microscopic resolution.

Various modifications of UBM including seated position UBM, prone position UBM, and indentation UBM are available and are used for specific indications.

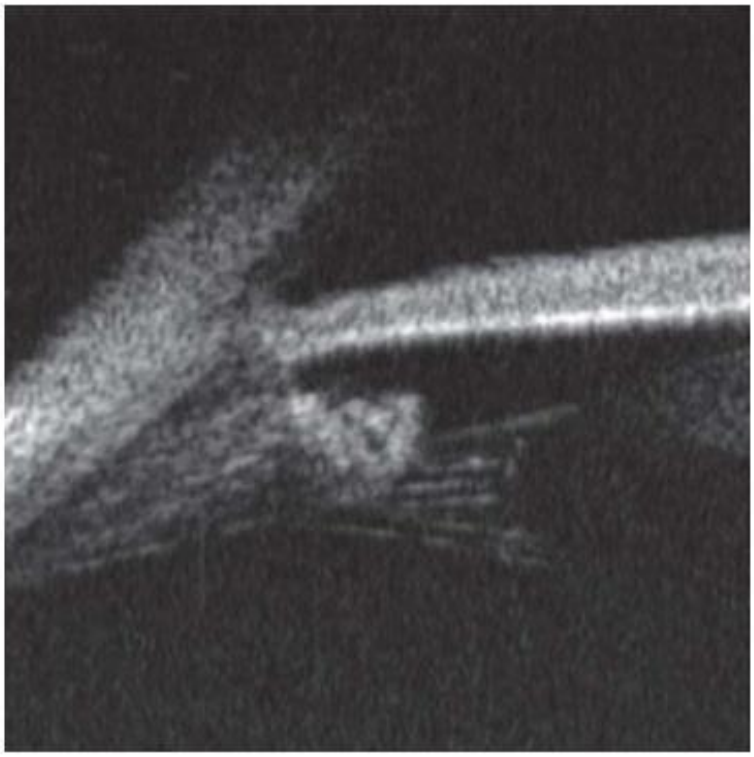
Since the images are produced with high resolution, it is possible to measure the various parameters accurately. For this certain landmarks are chosen, from which the measurements are made.

In a normal eye, the cornea is seen with its multiple layers with a highly reflective epithelium, high reflective bowman's layer and a high reflective line consisting of endothelium and Descemet's membrane.

The anterior chamber depth can measured from the internal corneal surface to the anterior surface of lens or the iris.

The anterior chamber assessment is made by identifying the sclera spur and the corneoscleral junction since they are consistently seen in most images.

All other measurements are taken from these landmarks.



ZONULES

Zonular dialysis is usually quantified by number of clock hours involved.

Radial images have to be taken through the lens, zonular bundles, and ciliary body.

A normal anterior zonule appears like a medium reflective line extending from the ciliary process to the margin of lens.

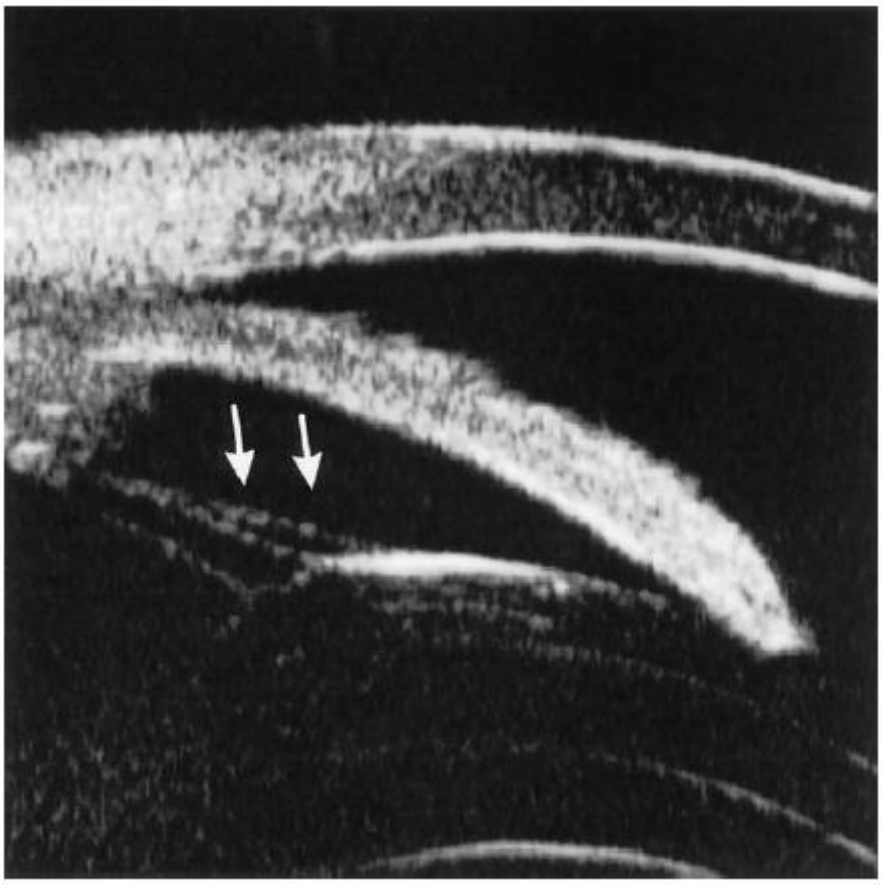
The anterior zonular fibers are imaged when appropriate techniques are used.

These techniques include placing the focal zone of transducer at anterior zonular region, orienting the scanning plane perpendicular to zonular path, and moving the probe slightly to optimize sound reflection from this structure.

The posterior zonular fibers are difficult to be detected because of difficulty scanning in this region due to the interference from lens margin. Missing zonular fibers are assumed by the failure to detect them on direct imaging.

Zonular stretch was the appearance of increased zonular length as compared with normal UBM zonular structure.

The length of anterior zonular fibers is normally less than 1 millimeter, but the stretched zonular fibers were more than 2 millimeter.



PXF DEPOSITION IN ZONULES

Eyes with partial zonular loss have showed increased lenticular curvature confined to the region of loss.

Notably, the degree of Pseudoexfoliation material observed in the eye does not seem to associate with the degree of zonular weakness.

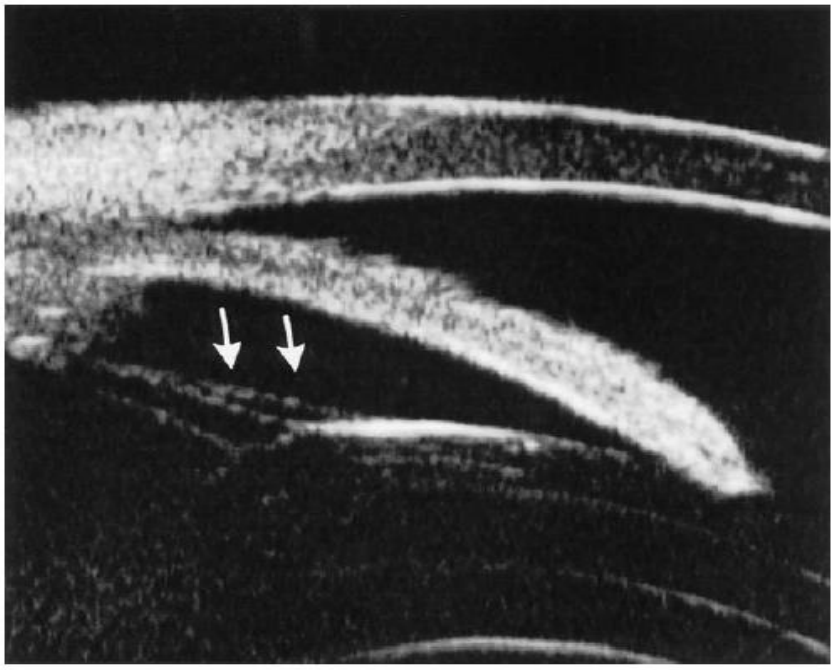
According to a previous study, they described three types of morphological changes of zonules in patients with Pseudoexfoliation with the help of UBM.

The types were described as granular, fan and winding type.

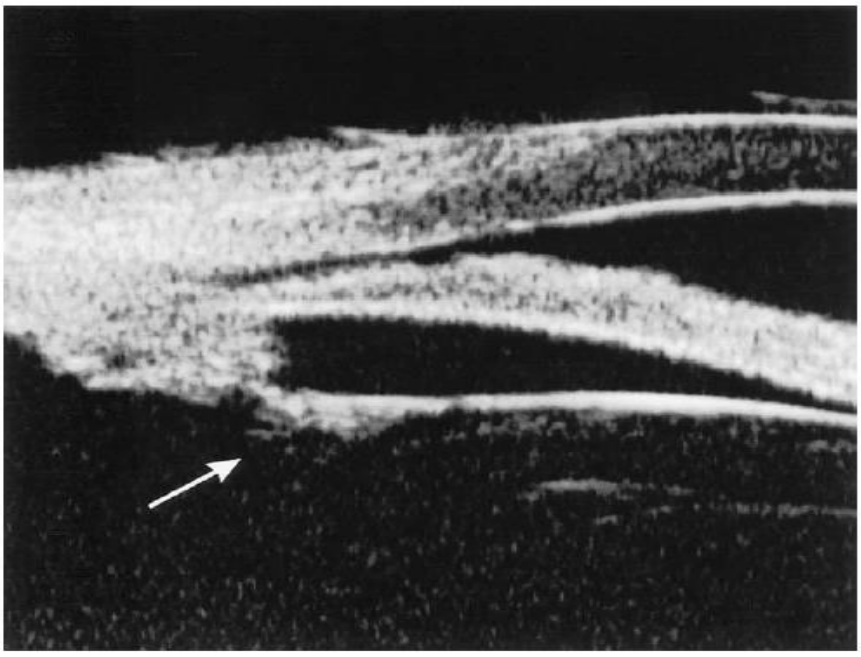
i. **Granular type** - Described as group of dots with no observable fibrous structure, the zonules had a normal shape and course without a clear, straight, consecutive signal.

ii. **Fan shaped type -** A fan shaped zonules is described with a deposit on each fiber, there is an absence of normal course and shape, and no straight line is observed.

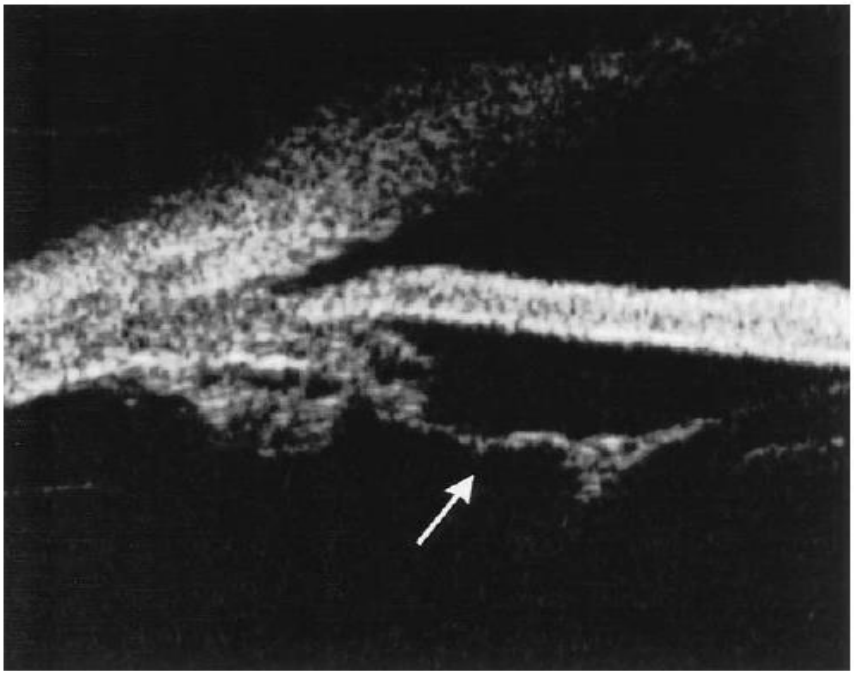
iii. Winding type - Zonules shows winding with a sclerotic change, there is an absence of normal course and shape.



GRANULAR TYPE



FAN TYPE



WINDING TYPE

COMPLICATIONS IN CATARACT SURGERY

This syndrome has been reported to be associated with increased intraoperative and post-operative complications during cataract surgery.

In PXF, the deposition of extracellular fibrillary material results in predictable alterations of tissues of the anterior segment, making cataract surgeries potentially challenging.

Surgeons must be aware of numerous intraoperative and post-operative issues in managing the patient with exfoliation syndrome.

Anterior chamber depth is an important predictor of intraoperative complications in eyes with Pseudo exfoliative syndrome.

An anterior chamber depth of less than 2.5 millimeter centrally is probably an important indication of zonular instability and it poses a significantly higher risk for intraoperative complications during surgery.

INTRAOPERATIVE COMPLICATIONS

During cataract surgery the chances of developing complications are

Sphincter tear

Difficult in nucleus delivery

Zonular rupture

Zonular dialysis

Posterior capsule rupture

Vitreous loss

Decent ration of IOL

Retained lens matter.

POST OPERATIVE COMPLICATIONS

There can be

Increased incidence of prolonged corneal Edema,

Severe anterior chamber reaction,

Endothelial loss,

Raised intra ocular pressure,

Anterior capsule fibrosis

Late dislocation of the intraocular lens within the bag or dislocation of the entire bag has also been encountered.

The preoperative planning for cataract extraction is first to identify PXF. Clinical diagnosis is best made by slit lamp biomicroscopy.

CLASSIC SIGNS:

PXF material on pupillary margin,

Moth eaten sphincter atrophy

Iris transillumination defects

Zone of central clearing on the anterior lens surface

OTHER SIGNS:

Hyperpigmentation of the trabecular meshwork and Sampaolesi's line

Corneal endothelial deposits of PXF or pigment from iris

Mild aqueous flare.

PXF exhibits a spectrum of disease severity; subclinical forms may show subtle findings.

Subtle findings, namely loss of melanin from pupillary margin, anterior chamber pigment dispersion after pupillary dilatation, deposition of pigment on anterior segment structures, and poor pupillary mydriasis.

Schlotze Schrehardt demonstrated 3 sites of potential rupture of zonules examined zonules by using scanning and transmission electron microscopy:

At the origin in the ciliary body,

In the pars plicata and

Attached to the anterior lens capsule.

Zonular fibers were disturbed by the infiltration of PXF fibers produced by pre equatorial lens epithelium, leading to zonular rupture. Further immunohistochemically studies postulated a lysosomal proteolytic mechanism of zonular disintegration.

Clinically, zonular weakness can be assessed at the slit lamp examination by grading the degree of Iridodonesis, Phacodonesis, both undilated and dilated, as well as number of clock hours involved.

Phacodonesis can be elicited by asking the patient to look in various directions and observing a fluttering movement of the lens, and is best assessed in undilated state.

The dilated examination can mask early Phacodonesis due to the stretching effect of cycloplegic drops on the zonules.

When dilated, the lens can also be assessed for centration and zonular dialysis. In particular, it is critical to identify any irregularity of the lens edge, which should be in round. A flattening of the lens edge suggests a focal weakening of zonules.

Manipulating the position of the eye and light source of the slit lamp allows for a more complete examination of the peripheral lens.

For example, to get the best view of the left lens edge, one can ask the patient to look to the left and rotate the slit lamp oculars and light source toward the right to access a deeper view of the sulcus and the lens edge. The lens is most commonly subluxated inferiorly in PXF syndrome.

Ultrasound biomicroscopy can be used to assess preoperative zonular status. Morphology of zonules along with characteristic PXF deposition can be studied in detail.

MANAGEMENT OF OPERATIVE COMPLICATIONS

THE SMALL PUPIL

Preoperatively, NSAIDs may be given to reduce the intraoperative miosis of pupil. Intraoperative measures are often necessary.

In phacoemulsification, a poorly dilated pupil can impede visualization of the anterior capsule and hinders the formation of a large enough Capsulorhexis, as well as nuclear fragmentation and removal.

Preoperatively, the dilated pupillary size can be documented at the slit lamp and decision can be made for the need of adjuncts for pupil dilation.

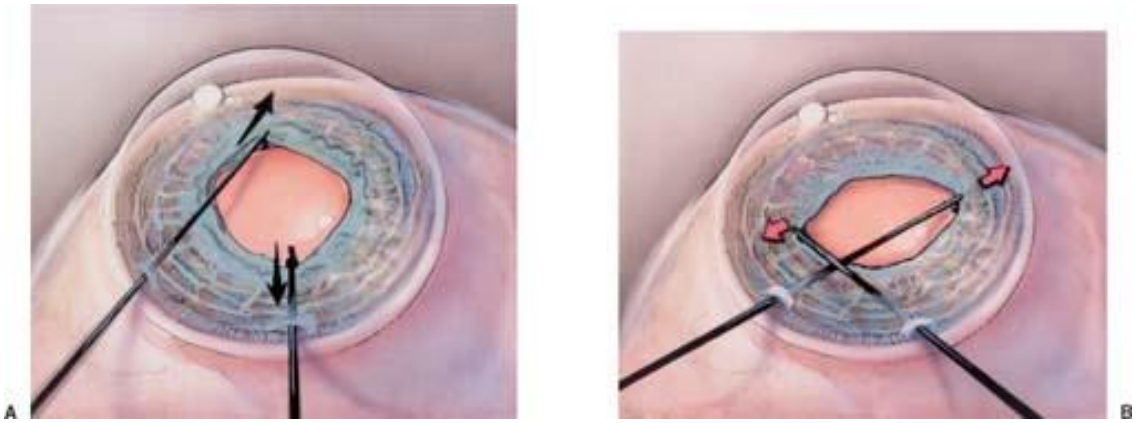
Various techniques are available for expansion of pupil:

PHARMACOLOGIC AND MECHANICAL

Intracameral pharmacologic dilators alpha 1 adrenergic receptor agonist, such as 10percentage phenylephrine may be used after paracentesis.

Moreover, the pupil can be enlarged by using highly cohesive ophthalmic viscosurgical devices, pupil stretching or pupil expansion devices.

MECHANICAL DEVICES MAY BE USED:



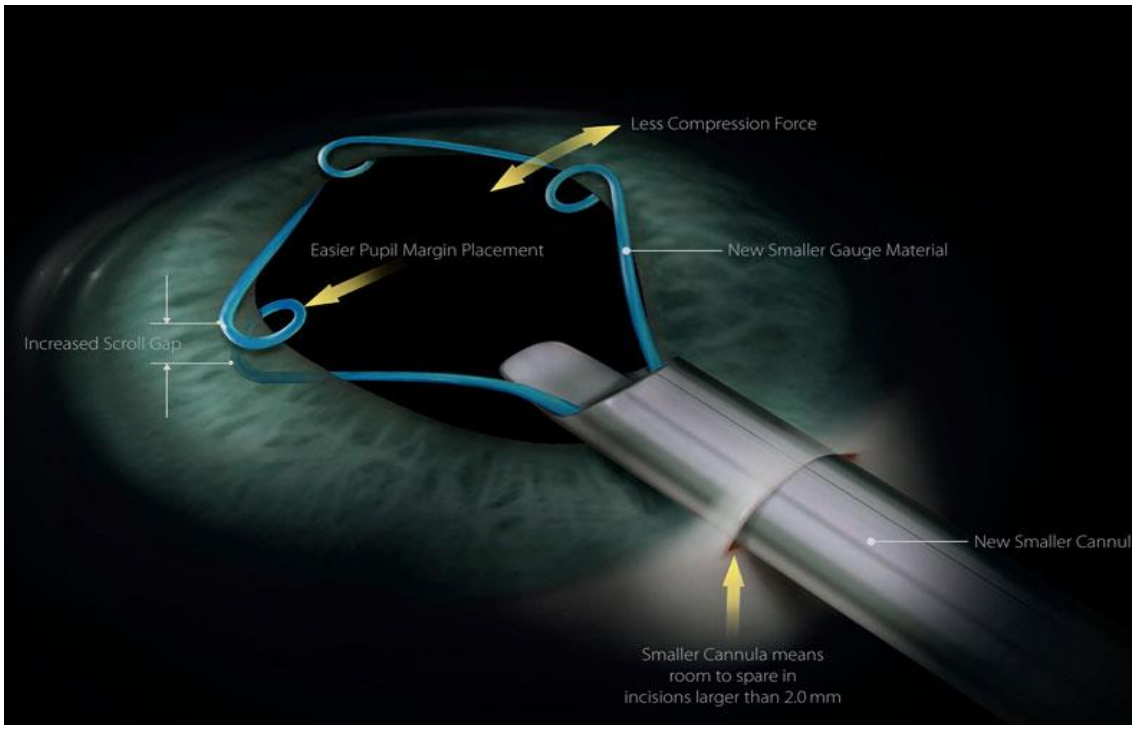
KUGLEN HOOKS

Kuglen hooks,

Beehler pupil dilator,

Malyugin rings,

Iris hooks.



MALYUGIN RINGS

This technique allows for visualization of any nuclear or cortical remnants that may remain hidden beyond the edges of a small pupil.

However, Posterior synechiae may be a cause for small pupil and should be lysed with a capsulorhexis forceps prior to further procedure Iris hooks can also serve to support the anterior capsulotomy, if zonular weakness is significant.

Care should be taken when handling the iris because injury to iris tissue can occur easily and causes bleeding.

Risks of mechanical pupillary dilation include sphincter tears and hyphemia

CAPSULORHEXIS

As zonular weakness results in less anterior capsular tension, a sharp instrument should be used to begin the Capsulorhexis, which makes the initial puncture more difficult.

When initiating the Capsulorhexis with a cystotome or with a capsule forceps, the anterior capsule may wrinkle due to weaker tension from periphery.

If striae are noticed during anterior capsule puncture, this may be the first clue for the presence of zonular weakness.

Zonular weakness may also notice if a circular rhexis takes on an oval or ellipsoid shape.

In cases with moderate to severe zonular weakness, it is difficult to tear the anterior capsule, and counter traction on the anterior capsule may be required.

This counter traction can be achieved with instruments such as a Kuglen hook or with iris hooks which are placed on a already torn edge of the anterior capsule.

Care must be taken to avoid tearing the anterior capsule with such types of hooks.

Forceps can also be used to grasp the capsule to tent upward and avoid downward pressure.

While the patient is lying supine, an eye with weak zonules may have a deep anterior chamber due to gravitational effect on the lens.

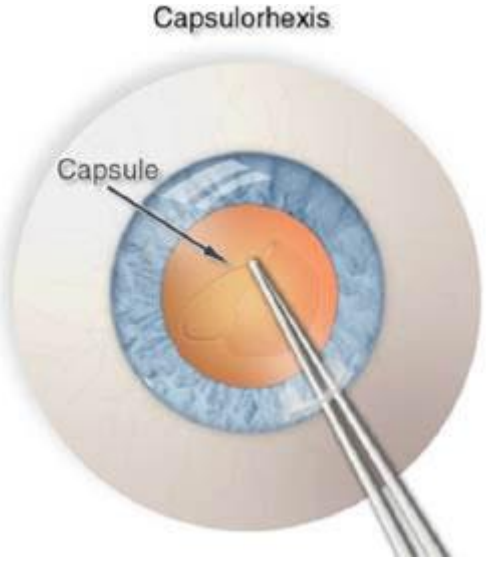
Intraoperatively, it is essential to use techniques that minimize zonular stress.

The size of Capsulorhexis is important in phacoemulsification, it is even more critical in eyes with zonular weakness.

The target size of the Capsulorhexis is about 5 to 5.5 millimeter to overlap with the optic of the IOL and to decrease incidence of posterior capsular opacification.

A smaller capsulotomy can also predispose to a postoperative contraction or phimosis due to the unopposed strong forces of fibrosis.

A small Capsulorhexis makes zonule friendly phacoemulsification difficult to perform, while a too large rhexis may preclude the use of capsular supporting devices, which require a sufficient anterior capsular edge.



CAPSULAR TENSION RING

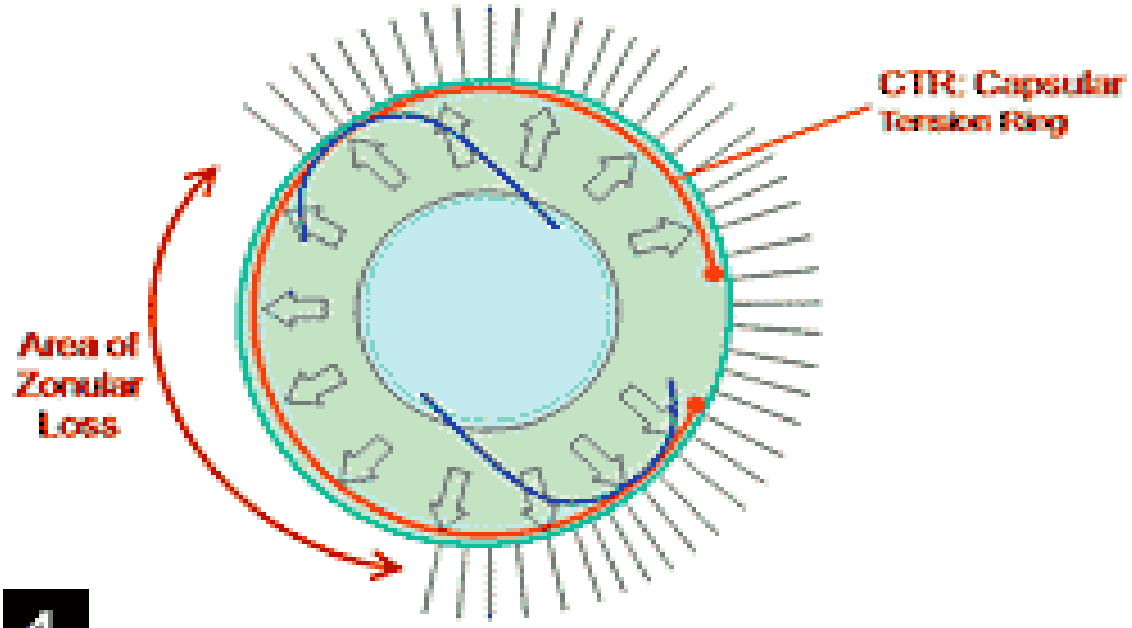
Patient with significant zonular instability, consideration of a polymethylmethacrylate capsule supporting device is mandatory. Example capsular tension ring.

Leger and Witschel first introduced polymethylmethacrylate CTR and demonstrated its placement in a human eye during surgery.

With the introduction of the capsular tension ring, the ability to perform safe cataract extraction with the implantation of a stable and well centered intraocular lens within the capsular bag has increased recently.

The CTR is a PMMA open ring device with blunt tipped eyelets at either end. The CTR is designed to be inserted into the capsular bag and left permanently in place.

CTR work by an imparting centrifugal force to the equator of capsular bag. This force is equalized throughout the entire zonular capsular apparatus, thus transmitting the tension from intact and normal zonules to those areas of zonules laxity or absence.



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Thus it distributes the zonular tension evenly at the capsule equator, keeping the capsular bag stretched and open during nucleus manipulation.

The CTR is indicated if there are less than 4 clock hours of zonulysis or mild Phacodonesis and may be inserted at any time after Capsulorhexis has been made.

CAPSULAR TENSION SEGMENT

It also prevent vitreous prolapse, improves IOL centration, reduce tilt, reduce intraoperative zonular separation, capsule rupture, decrease capsular fibrosis, posterior capsular opacification also improves IOL centration and uncorrected visual acuity.

However, CTRs require an intact capsular bag and should not be used if any capsular tears are present. CTRs appear to have no effect on the refractive results from the cataract surgery.

Although CTRs are beneficial, they may also cause iatrogenic injury to the capsular bag during implantation as well as increases the difficulty of cortical removal after insertion of CTR.

In order to be effective, the CTR should be larger in diameter than capsular bag diameter and an appropriately sized CTR should have its ends overlap slightly.

Ultrasound biomicroscopy had shown that a correctly placed CTR lies between the IOL haptic and ciliary body with no iris touch, and this position is stable, safe, and consistent.

To minimize the iatrogenic zonular injury of ring insertion, the authors recommend retracting the CTR injector after the CTR tip has entered the capsular bag.

This retraction allows the tip of CTR to follow its natural curvature into the capsular fornix rather than locally pushing the capsular fornix away from incision.

If the purpose of CTR implantation is postoperative IOL centration and stability, then it is ideal to insert the CTR immediately before IOL implantation.

If the purpose of the CTR implantation also includes intraoperative centration and stability, then CTR can be aimed into the space between cortex and anterior lens capsule.

The potential space can be created using gentle visco dissection, which reduces the chance of cortex material entrapment around the CTR.

Despite viscodissection, cortical removal is more challenging and hence early CTR implantation is recommended only, if necessary, for intraoperative stability and centration.

CTR can be placed at any time during the surgery. Once a continuous curvilinear capsulorrhexis is made, the placement of CTR with nucleus or significant cortex will make the removal of those structures much more difficult.

If a CTR is inserted prior to the nucleus being removed, copious viscodissection under the anterior capsule and into the fornices of the capsular bag should be attempted.

If the CTR is inserted after the nucleus is removed but prior to cortical aspiration, the surgeon needs to be prepared for a more thorough irrigation and aspiration I/A as the cortical material is often trapped by the ring against the bag.

Capsular tension segments CTS are indicated in greater than 4 clock hours of zonular dehiscence, or any zonulysis in the context of an anterior or posterior capsular rent.

The segmental support provided by Capsular tension segments CTS offers capsular stability without promulgating any capsular rents.

CTS can be stabilized intraoperatively with iris hooks, and scleral fixated after removal of lens contents.

CTRs being accidentally inserted into the anterior chamber angle instead of the capsular bag and may not be identified until postoperatively.

Insertion into the vitreous has also happened either through an iatrogenic capsule tears from ring insertion or through an occult bag laceration.

Removing a CTR from the vitreous space can be done in several ways directly removing the ring through a sclerostomy, cutting the ring into pieces and removing it by capturing it and retracting it into a ring injector.

Cases of ring dislocation or accidental insertion into the vitreous are often best handled by posterior segment surgeries. It is also possible for the CTR to be placed in the ciliary sulcus.

Great care must be taken to confirm that the capsular bag is intact before placing a CTR. If there is any question about the status of the bag, the ring should not be inserted. Again, CTS can be used in cases in which the capsular bag integrity is questionable.

In cases of obvious significant zonular absence or laxity, a device which can be suture fixated to the scleral wall such as CTR or CTS is more logically used.

HYDRODISSECTION AND VISCODISSECTION

Hydrodissection should be carried out with a minimal stress on the zonules, especially if the surgeon attempts to rotate the nucleus within the capsular bag.

If the zonular weakness is quiet significant, injection of OVD between the lens capsule and cortex may be useful.

This reduces the chance of trapping cortex during CTR insertion and creates a greater cortico capsular cleavage than hydrodissection alone.

CORTICAL REMOVAL

While nucleus and epinucleus removal often may be achieved in a zonule friendly manner, cortical removal may be difficult and more traumatic.

A tangential stripping method can also be used in combination with gentle centripetal movements to allow cortical material to separate from capsular bag.

At this stage, it is important to remember that cortex may be trapped behind a CTR. If this is the case, then to prevent further zonular tearing, a tangential stripping technique may be needed.

In some problematic situations, dry removal with a cannula may be required. Although these techniques may be time-consuming, they will result in best chance of preserving zonular fibers.

IOL INSERTION

Although most foldable PCIOLs are judicious options in these cases, some authors believe that slowly unfolding one piece acrylic IOL is the best choice.

This design IOL allows the surgeon to dial the IOL gently into capsular bag and place the flexible haptics in desired orientation with minimal capsular and zonular stress. The adjunctive use of a CTR also provides excellent in-the-bag centration.

In the presence of zonular weakness, a sulcus placed, three pieces foldable PCIOL is not generally recommended because of the likelihood of decentration.

CORNEAL ENDOTHELIUM

Intraoperatively, application of a dispersive OVD is suggested to reduce postoperative corneal edema.

OVD should be applied repeatedly, before sculpting or chopping, between removal of quadrants, and before irrigation/aspiration.

Some studies suggest that use of BSS plus as an irrigation solution and even cooled BSS at 12 degree Centigrade, may also reduce endothelial cell loss and postoperative corneal edema.

Moreover, techniques that reduce energy dispersed during phacoemulsification are useful, such as ensuring a safe working distance from endothelium, using chopping techniques rather than divide & conquer.

Postoperatively, due to breakdown in blood-aqueous barrier, increased inflammation including higher levels of flare, fibrin, and posterior synechiae can cause worsening of endothelial cell dysfunction.

IOP

Early IOP spikes are much more common in patients with PXF syndrome.

Levkovitch Verbin et al demonstrated that IOP elevation occur most commonly 4 hours postoperatively in patients with PXF, 38 percentage of PXF eyes had a pressure greater than 25 millimeter Hg.

It is recommended to treat inflammation and increased intraocular pressure more aggressively, and potentially taper corticosteroids more gradually.

Instillation of an antihypertensive drops timolol 0.5 percentages or bimatoprost postoperatively was revealed to be effective in preventing IOP spikes greater than 30 millimeter Hg. Moreover, postoperative oral acetazolamide can also be used as an adjunct.

However, treatment of inflammation should be balanced with steroid response.

All of these complications make cataract surgery a challenge in patients with pseudo exfoliation syndrome.

PART II

DETAILED STUDY PROPOSAL

TITLE

ROLE OF ZONULAR ASSESSMENT BY ULTRASOUND BIOMICROSCOPY BEFORE CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME TOWARDS ENSURING SATISFACTORY PCIOL IMPLANTATION

AIM & OBJECTECTIVE

To detect the morphology of zonules by UBM before doing cataract surgery.

To predict the intraoperative complications during cataract surgery.

To prevent the zonular instability by using capsular tension ring during surgery.

MATERIALS & METHODS

STUDY DESIGN

Prospective observational study

STUDY PERIOD

8 months

STUDY CENTRE

Department Of Ophthalmology, Government Rajaji Hospital, Madurai

SAMPLE SIZE

50 patients fulfilling the inclusion criteria

INCLUSION CRITERIA

Patients with senile immature cataract associated with pseudo exfoliation in pupillary margin and anterior lens capsule .

Age of the patient between 50 to 80 yrs.

EXCLUSION CRITERIA:

Patients with secondary open angle glaucoma associated with pseudo exfoliative syndrome.

All types of Mature Cataract

Traumatic cataract / absorbed lens

Complicated cataract

True exfoliation

METHODOLOGY

Prospective, observational study to determine the pattern of pseudo exfoliation in zonules using Ultrasound biomicroscopic technique and to assess the operative outcome in each type.

It was done in patients presenting to the cataract clinic of the Department of Ophthalmology of Government Rajaji Hospital, Madurai for a period of 8 months during JAN 2017 to AUG 2017.

A total of 50 patients were studied. Patients satisfying inclusion criteria were selected. Detailed history should be noted. Their visual activity was recorded by Snellen's chart.

Anterior segment examination for pseudo exfoliative material deposition, pupillary size, anterior chamber depth, grading of lens opacity was made with slit lamp, tension by applanation tonometer, angles by gonioscopy was recorded. Retinoscopy refraction was done. Fundus examination was done using 90D.

Ascan ultrasound biometry for determing axial length, keratometry for corneal curvature were done.

With SRK II formula Intraocular lens power was calculated.

Then Ultrasound biomicroscopic assessment was studied to be done for these patients and different types of zonular pattern were noted.

Operative complications in cataract surgery for different patterns were noted. Statistical analysis of the different groups of patients were studied.

PROCEDURE:

Patients satisfying inclusion criteria were selected and informed consent about the procedure was obtained.

After initial history taking, Visual acuity was recorded by Snellen's chart.

Intra ocular pressure is measured by applanation tonometer.

Slit lamp examination is done. Lids, conjunctiva, cornea, anterior chamber depth, Iris, Pupillary margins, pupillary reactions, lens details are noted.

Angles are examined by Gonioscopy.

For dilating the pupil 1% tropicamide and phenylepherine eye drops is instilled in the conjunctival sac. After 20 minutes ,pupillary dilatation is

measured. Lens grading is done by using Lens opacities classification system (LOCS).

Fundus examination by +90D lens is done.

Retinoscopy refraction and subjective verification is done.

Axial length, corneal curvature are measured by Ascan and Keratometry.

Nasolacrimal duct patency has to be checked.

Intraocular lens power is calculated by using SRK II formula.(P=A-0.9K-2.5L).

Ultrasound biomicroscopy is performed in supine position after instilling topical anesthetic eye drops.

Under standardized illumination a silicon eyecup of appropriate size is inserted between the eyelids and filled with normal saline which acts as a coupling medium.

Patient is asked to look straight with fellow eye for fixation.

The Transducer probe is placed inside the coupling medium with care not to touch the corneal surface. Images are studied / recorded at 12:00, 3:00, 6:00 and 9:00 o'clock position. At each location, three images

are taken. Clear images are obtained when the scanning planes are oriented perpendicular to the zonules.

From the obtained images in all four quadrants the different types of morphological changes are noted and classified into granular, fan and winding type.

In my study I have divided the study groups into granular, winding and fan type, when the individual type is present in three or more quadrants.

The following zonular patterns are to be identified

I. **Granular type** - Described as group of dots with no observable fibrous structure, the zonules had a normal shape and course without a clear, straight, consecutive signal.

II. **Fan shaped type -** A fan shaped zonules is described with a deposit on each fibre, there is an absence of normal course and shape, and no straight line is observed.

III. **Winding type** - Zonules shows winding with a sclerotic change, there is an absence of normal course and shape.

Real time images are captured on the monitor.

Different types of zonular patterns are noted.

During Small incision cataract surgery (SICS) any operative complications like poor pupillary dilatation, posterior capsular rent, bag instability in the different groups of subjects and their management is also noted.

Post-operative visual acuity is determined after 2 week. Statistical analysis is done.

Statistical analysis

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using SPSS 16 and Sigma Stat 3.5 version.

Using this software range, frequencies, percentages, means, standard deviations, chi square and 'p' values were calculated by One way ANOVA and Chi-square test was used to test the significance of difference between quantitative variables.

A 'p' value less than 0.05 is taken to denote significant relationship.

OBSERVATION & ANALYSIS

TABLE 1 - AGE DISTRIBUTION

Of the studied population, 8 were less than 60 years, 20 were between 61-65 years, 17 were between 66- 70 years & only 5 were above 70 years.

Age in years	No.of cases
≤ 60	8
61 - 65	20
66 - 70	17
> 70	5
Total	50

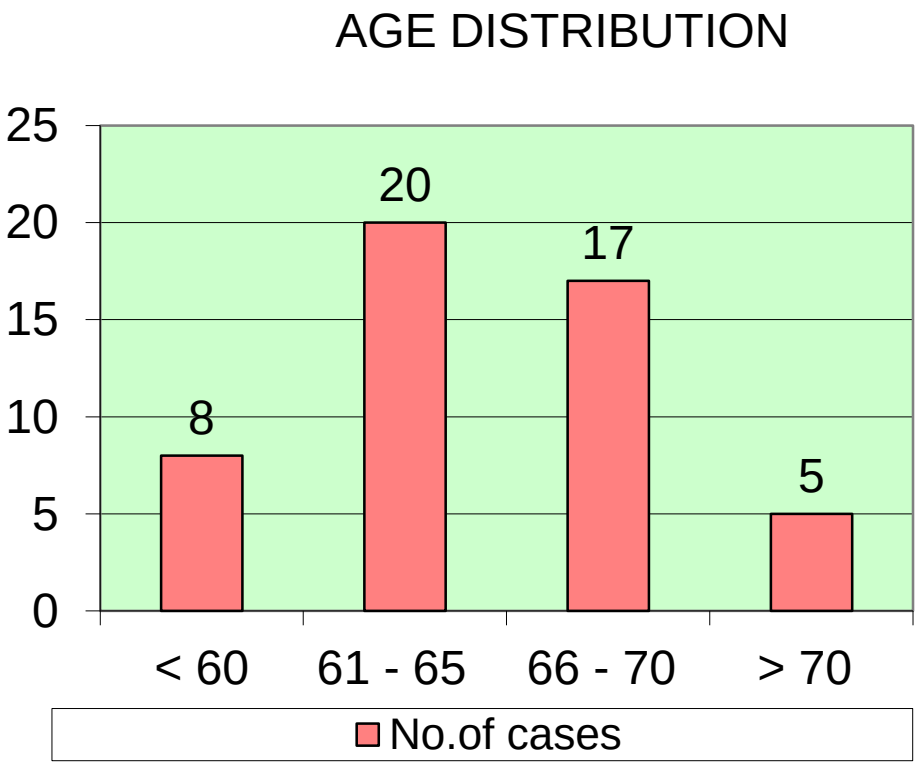


TABLE 2

SEX DISTRIBUTION

Among the 50 studied population 54% were males and remaining 46% were females.

Sex	No.of cases
Male	27
Female	23
Total	50

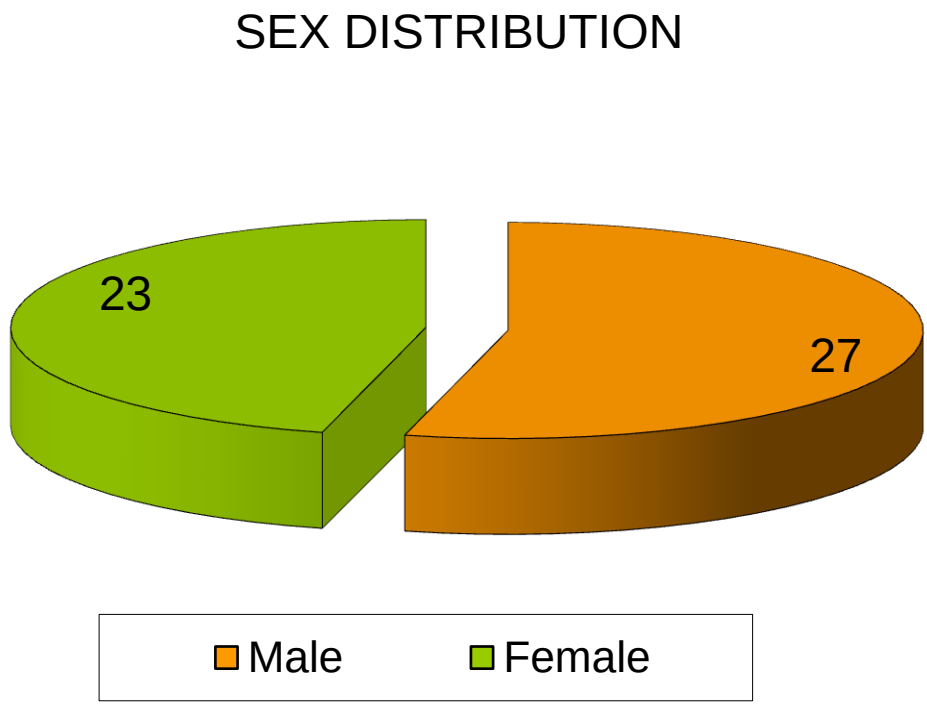


TABLE 3

PSEUDO EXFOLIATION UNILATERAL VS BILATERLAL

Among the 50 studied populations the slit lamp examinations showed exfoliation unilateral pseudo exfoliation were 15 cases and bilateral pseudo exfoliation were 35 cases.

SLE-PXF	No.of cases
Unilateral	15
Bilateral	35
Total	50

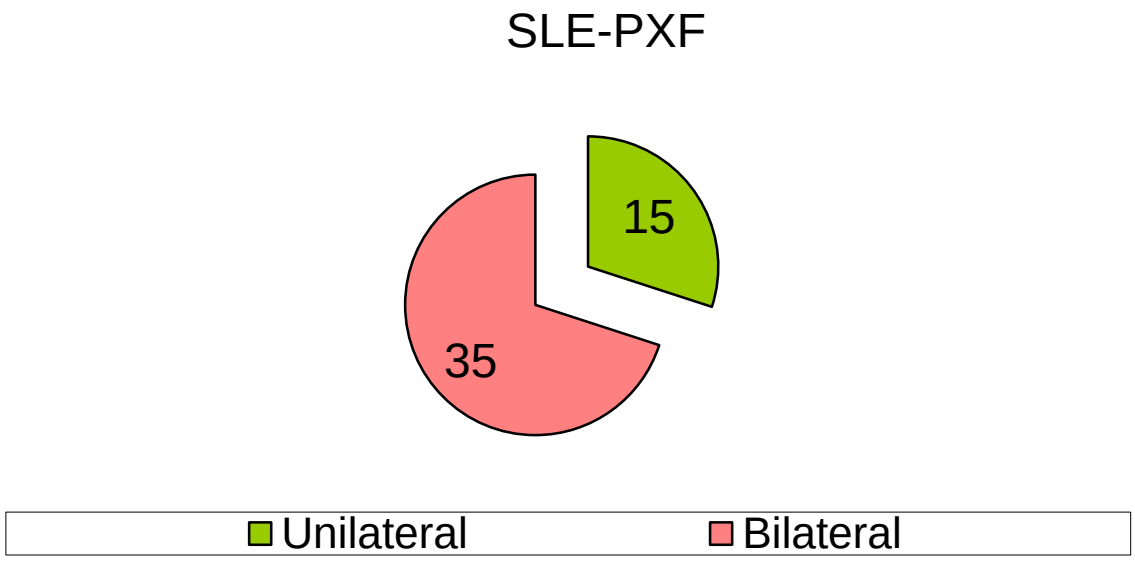


TABLE 4

SEX DISTRIBUTION VS ZONULAR PATTERN

Among the 50 studied populations the 27 were MALE and 23 were FEMALE.

27 male showed granular type 21, fan type 3 and winding type 3.

23 female showed granular type 15, fan type 8 and winding type was null.

Sex	Granular	Fan	Winding
Male (27)	21	3	3
Female (23)	15	8	0
Total (50)	36	11	3

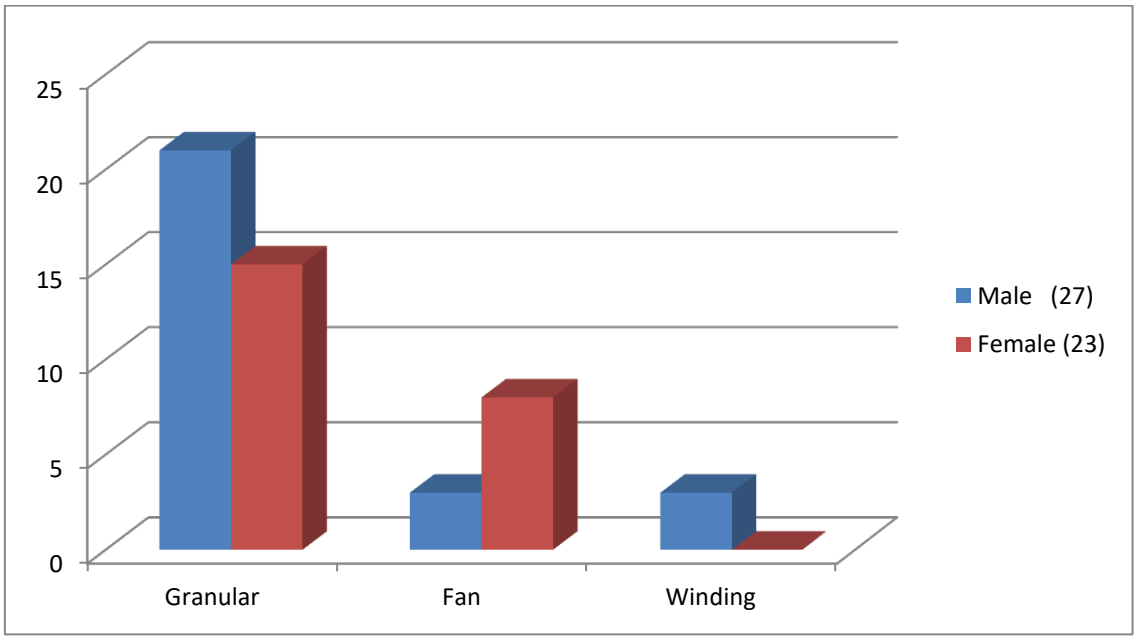


TABLE 5

PUPILLARY SIZE AFTER DILATATION

Among the 50 studied populations the Pupillary size after dilatation noted are as follows in which pupillary size of 5 in 11 cases, pupillary size of 6 in 13 cases, pupillary size of 7 in 19 cases and pupillary size of 8 in 7 cases.

Pupillary size	No.of cases
5	11
6	13
7	19
8	7
Total	50

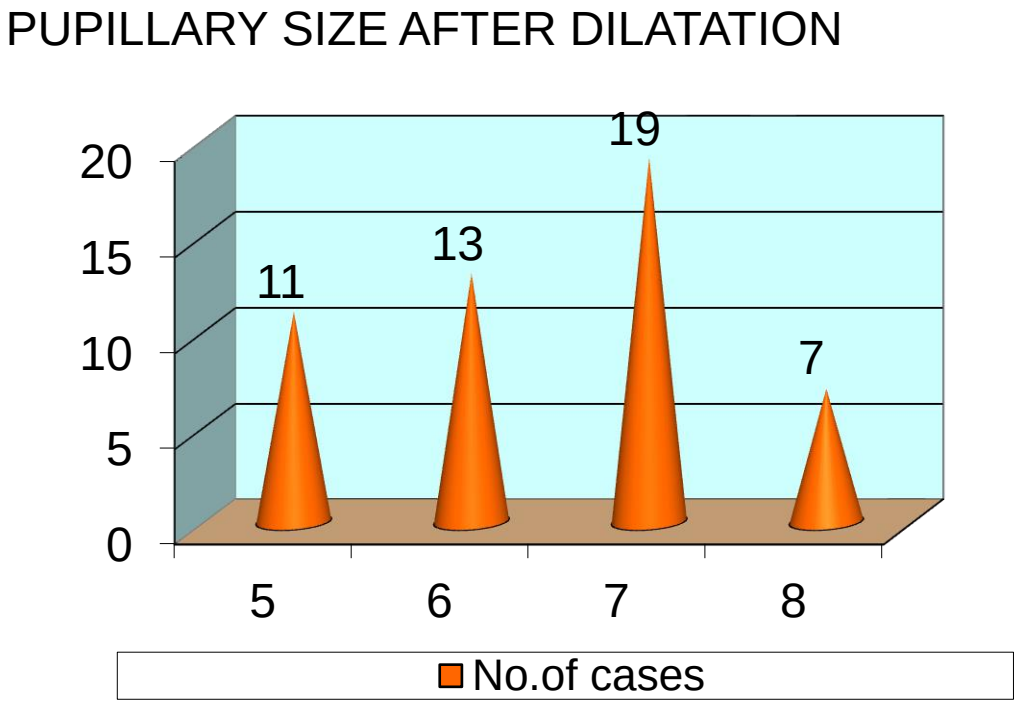


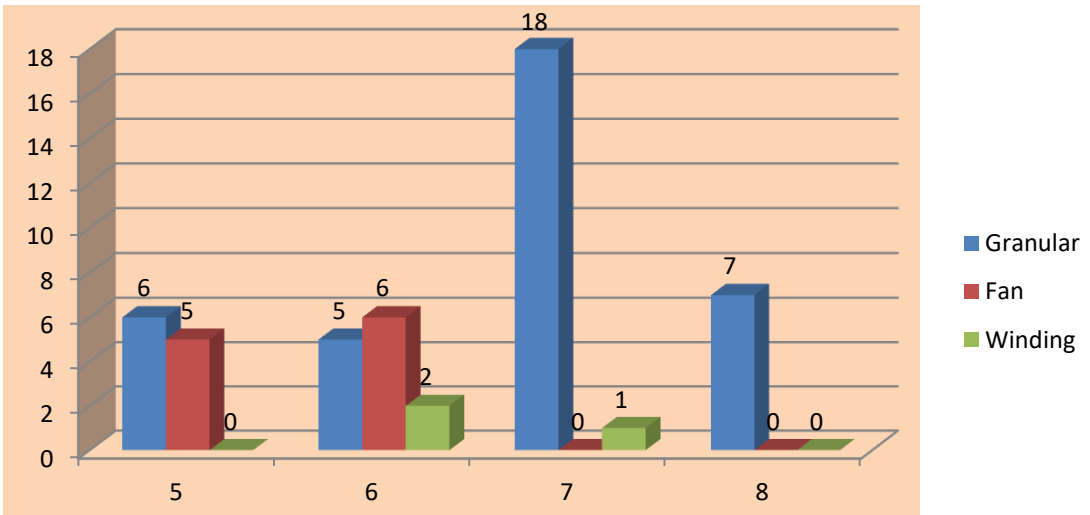
TABLE 6

PUPILLARY SIZE VS ZONULAR TYPE

Among the 50 studied populations in the PUPILLARY SIZE VS ZONULAR TYPE were taken.

Granular type showed 5mm in 6 cases, 6mm in 5 cases, 7mm in 18 cases and 8mm in 7 cases. Fan type showed 5mm in 5 cases and 6mm in 6 cases. Winding type showed 6mm in 2 case and 7mm in 1 cases.

Pupillary size (mm)	Granular	Fan	Winding
5	6	5	0
6	5	6	2
7	18	0	1
8	7	0	0



Pupillary size (mm)

TABLE 7

AVERAGE PUPILLARY SIZE VS ZONULAR TYPE

Among the 50 studied populations in the AVERAGE PUPILLARY SIZE VS ZONULAR TYPE were taken. Granular type showed an average pupillary size of 6.70 mm in 36 cases, fan type showed average pupillary size of 5.50 mm in 11 cases and winding type showed average pupillary size of 6.30 mm in 3 cases.

UBM	No.of cases	Pupillary size
Granular	36	6.70
Fan	11	5.50
Winding	3	6.30

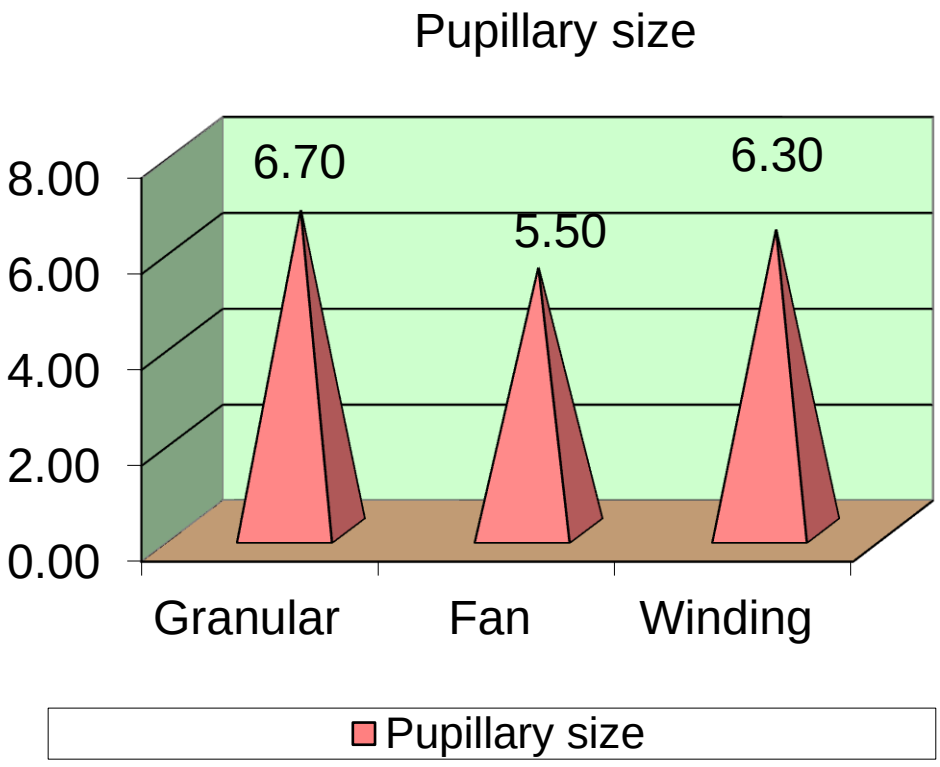


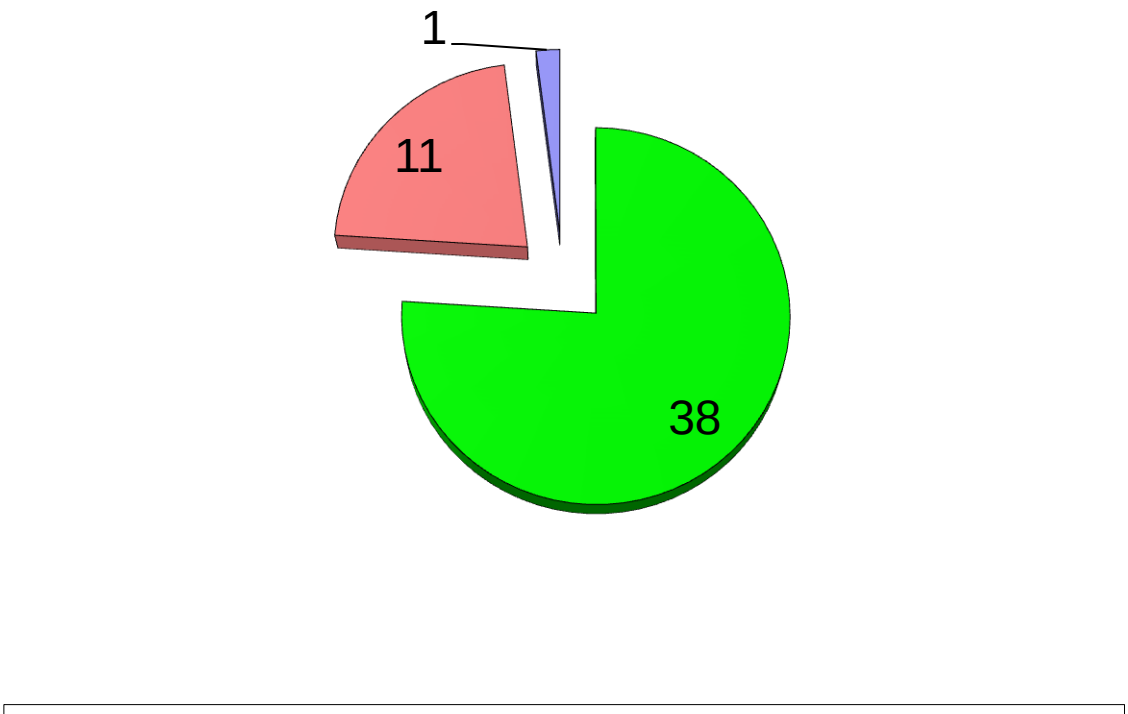
TABLE 8

SURGERY

Among the 50 studied populations for 38 cases done by SICS WITH PCIOL in which for 4 cases CTR/CTS were placed, for 11 cases done by SICS WITH MULTIPLE SPHINCTEROTOMY in which for 3 cases CTR/CTS were placed and for 1 case done by SICS WITH SFIOL.

SURGERY	NO.OF CASES	CTR / CTS
SICS WITH PCIOL	38	4
SICS WITH MULTIPLE SPHINCTEROTOMY WITH PCIOL	11	3
SICS WITH SFIOL	1	0
TOTAL	50	7

SURGERY



CTR RING

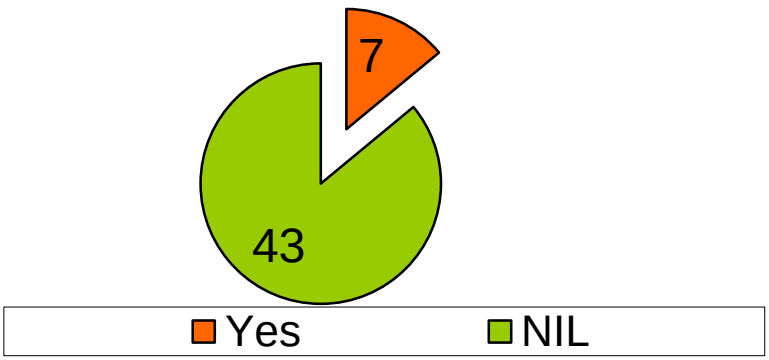


TABLE 9

COMPLICATIONS

Among the 50 studied populations the complications noted are 9 cases had PC RENT, 8 cases had ZONULAR DIALYSIS and rest of the 33 cases had no complication.

Complications	No.of cases
PC RENT	9
ZONULAR DIALYSIS	8
NIL	33

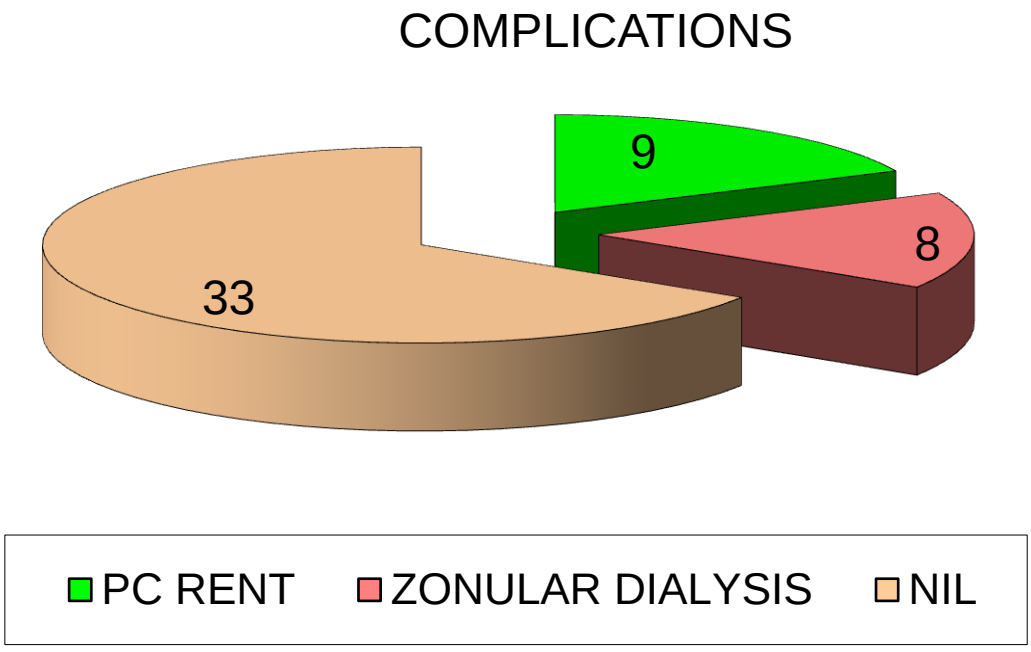


TABLE 10

OPERATIVE COMPLICATION FOR DIFFERENT ZONULAR PATTERN

Among the 50 studied populations the operative complication for different zonular pattern is as follows.

I. Among 50 cases 36 cases were granular type which is 72 % of the total cases, The operative complication in granular type is 7 cases of total 36 cases which is 19 percentage
II. Among 50 cases 11 cases were fan type which is 22 % of the total cases, The operative complication in fan type is 9 cases of total 11 cases which is at 80 percentage
III. Among 50 cases 3 cases were winding type which is 6 % of the total cases, The operative complication in winding type is 1 cases of total 3 cases which is at 33

Using SPSS 16 and Sigma Stat 3.5 version. The chi square and 'p' values were calculated by One way ANOVA.

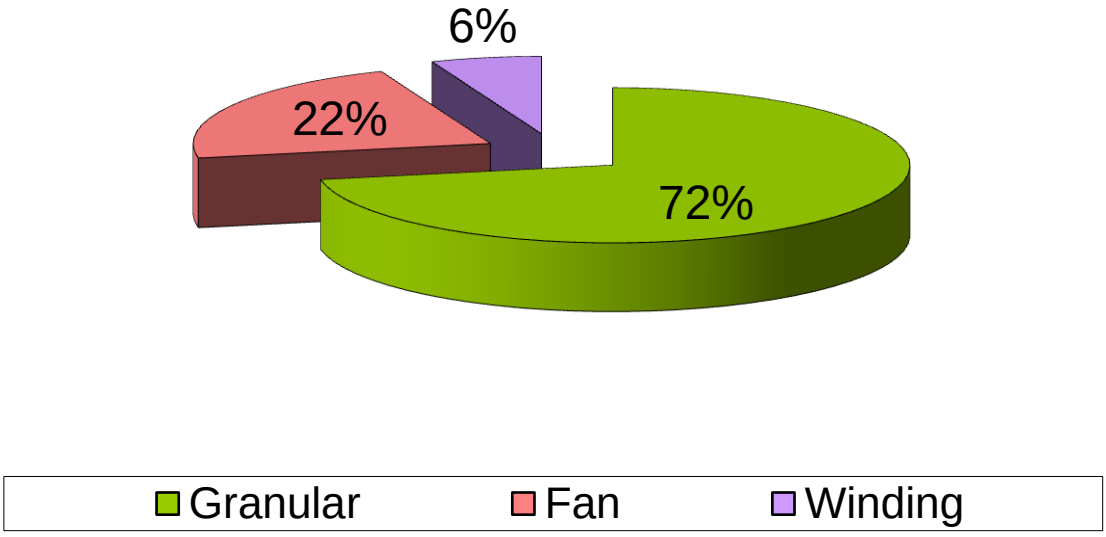
Depending upon the number of cases and complications noted for granular and winding type vs fan type that is 8/39 vs 9/11 from this

Chi square value obtained is 11.76

Significant is less than 0.001.

	UBM		OPERATIVE COMPLICATIONS	
	No.of cases	%	No.of cases	%
Granular	36	72	7	19
Fan	11	22	9	81
Winding	3	6	1	33
			8 / 39 VS 9 / 11	
	CHI SQUARE VALUE		11.76	< 0.001 SIGNIFICANT

PERCENTAGE OF ZONULAR PATTERNS



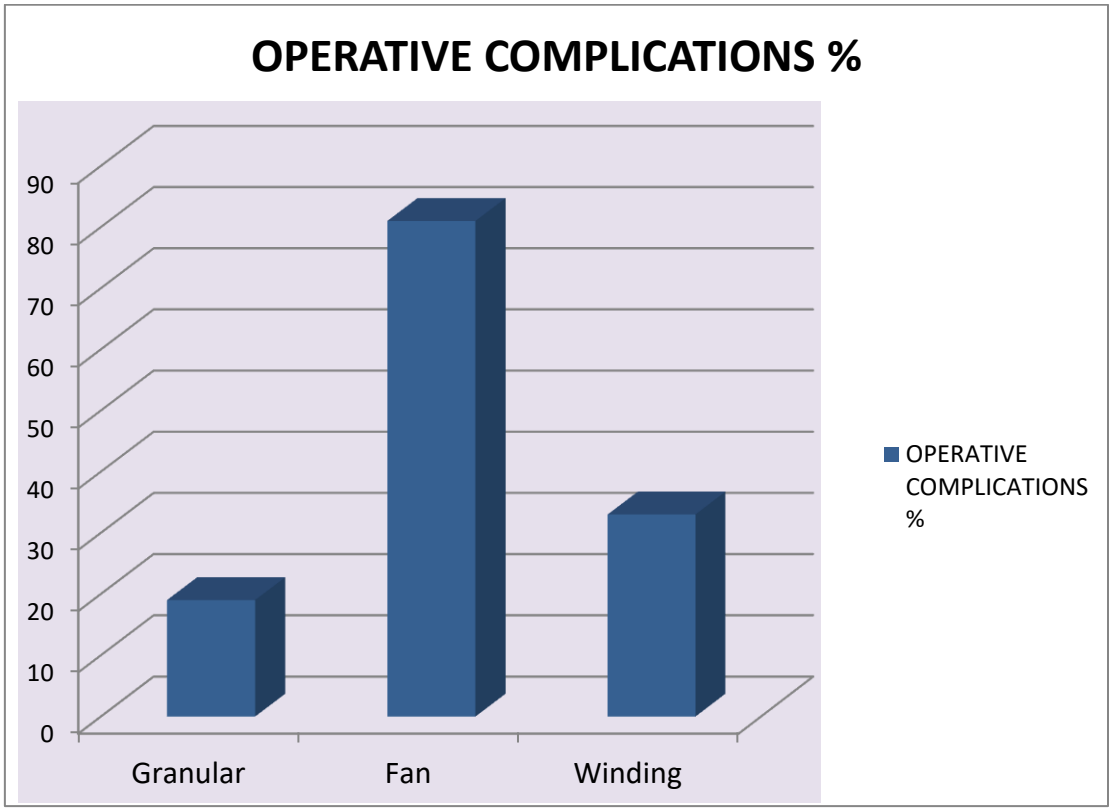
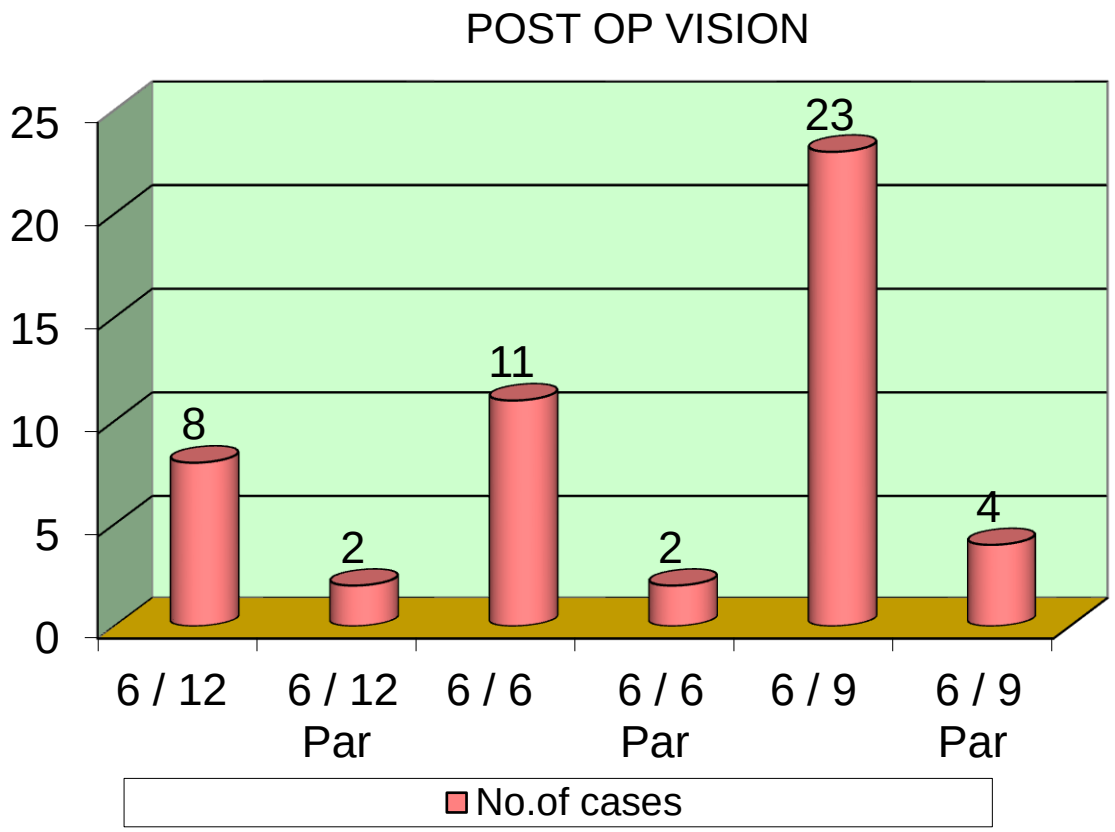


TABLE 12

POST OPERATVE VISION

Among the 50 studied populations the POST OPERATIVE VISION were 6/12 in 8 cases, 6/12 partial in 2 cases, 6/6 in 11 cases, 6/6 partial in 2 cases, 6/9 in 23cases, 6/9 partial in4 cases were noted.

Post op vision	No.of cases
6 / 12	8
6 / 12 Par	2
6 / 6	11
6 / 6 Par	2
6 / 9	23
6 / 9 Par	4
Total	50


POST OP VISION
25
20
15
10
5
0
8
2
11
2
23
4
6 / 12
6 / 12 Par
6 / 6
6 / 6 Par
6 / 9
6 / 9 Par
No.of cases

SUMMARY

Of the studied population, 8 were less than 60 years, 20 were between 61-65 years, 17 were between 66- 70 years & only 5 were above 70 years.

Among the 50 studied population 54% were males and remaining 46% were females.

Among the 50 studied populations the slit lamp examinations showed exfoliation unilateral pseudo exfoliation were 15 cases and bilateral pseudo exfoliation were 35 cases.

Among the 50 studied populations the 27 were MALE and 23 were FEMALE. 27 male showed granular type 21, fan type 3 and winding type 3.23 female showed granular type 15, fan type 8 and winding type was null.

Among the 50 studied populations the Pupillary size after dilatation noted are as follows in which pupillary size of 5 in 11 cases, pupillary size of 6 in 13 cases, pupillary size of 7 in 19 cases and pupillary size of 8 in 7 cases.

Among the 50 studied populations in the PUPILLARY SIZE VS ZONULAR TYPE were taken. Granular type showed 5mm in 6 cases, 6mm in 5 cases, 7mm in 18 cases and 8mm in 7 cases. Fan type showed

5mm in 5 cases and 6mm in 6 cases. Winding type showed 6mm in 2 cases and 7mm in 1 case.

Among the 50 studied populations in the AVERAGE PUPILLARY SIZE VS ZONULAR TYPE were taken. Granular type showed an average pupillary size of 6.7 mm in 36 cases, fan type showed average pupillary size of 5.5 mm in 11 cases and winding type showed average pupillary size of 6.3 mm in 3 cases

Among the 50 studied populations for 38 cases done by SICS WITH PCIOL in which for 4 cases CTR/CTS were placed, for 11 cases done by SICS WITH MULTIPLE SPHINCTEROTOMY in which for 3 cases CTR/CTS were placed and for 1 case done by SICS WITH SFIOL.

Among the 50 studied populations the complications noted are 9 cases had PC RENT, 8 cases had ZONULAR DIALYSIS and rest of the 33 cases had no complication.

Among the 50 studied populations the operative complication for different zonular pattern is as follows.

I. Among 50 cases 36 cases were granular type which is 72 % of the total cases, The operative complication in granular type is 7 cases of total 36 cases which is 19 percentage

II. Among 50 cases 11 cases were fan type which is 22 % of the total cases, The operative complication in fan type is 9 cases of total 11 cases which is at 80 percentage

III. Among 50 cases 3 cases were winding type which is 6 % of the total cases, The operative complication in winding type is 1 cases of total 3 cases which is at 33

Using SPSS 16 and Sigma Stat 3.5 version. The chi square and 'p' values were calculated by One way ANOVA. Depending upon the number of cases and complications noted for granular and winding type vs fan type that is 8/39 vs 9/11 from this **chi square value obtained is 11.76, Significant is less than 0.001**.

Among the 50 studied populations the POST OPERATIVE VISION were 6/12 in 8 cases, 6/12 partial in 2 cases, 6/6 in 11 cases, 6/6 partial in 2 cases, 6/9 in 23cases, 6/9 partial in4 cases were noted.

DISCUSSION

Pseudo exfoliation syndrome is commonly encountered worldwide, which can result in so many complications during cataract surgery, if not given utmost importance. Pseudo exfoliation is an age related generalized disorder of extra cellular matrix which will alter the biochemical property of the tissue in which it is deposited.

Its prevalence increases with age and involves both the gender with female preponderance worldwide. But, in my study there is a higher incidence seen in male population similar to the journal published in 2015 International journal medical science and clinical intervention.

In our studied population most of the people with Pseudoexfoliation were between 61-70 years of age when compared to other age group.

Among our studied populations the slit lamp examinations showed that bilateral presentation of pseudo exfoliation were more compared to unilateral pseudo exfoliation.

In my study, I have dealt about the intraoperative complications of cataract surgery in patients with Pseudoexfoliation.

Complications often encountered are poor pupillary dilatation, posterior capsular rent and zonular instability

Pre operatively the zonular morphology can be assessed by using ultrasound biomicroscopy and necessary precautions can be taken while doing cataract surgery.

In a study by Zaher Sbeity et al, on Ultrasound biomicroscopy of zonular anatomy in clinically unilateral exfoliation syndrome, evaluated the ability of ultrasound biomicroscopy to detect abnormalities in the zonules

Ultrasound biomicroscopy (UBM) is a high resolution imaging of anterior segment which allows objective & reproducible method of evaluation of angle morphology. It gives two dimensional gray scale images with a depth of penetration of about 5mm and hence the structures from the conjunctiva, cornea, angle, to the ciliary body & anterior layers of lens zonules & pars plana can be visualized. Hence it is used to assess the zonular morphology before cataract surgery.

In a study by Kosuke Inazumi et al , on Ultrasound Biomicroscopic Classification of Zonules in Exfoliation Syndrome, three different types of zonular patterns were studied. The three different morphological types are granular, fan and winding types with increased incidence of granular type of zonules.

In my study, conducted in Government Rajaji hospital, Madurai, UBM examination of 50 patients with senile immature cataract and Pseudoexfoliation showed that granular type of zonules is significantly

high followed by fan type and winding type of zonules. Among the studied population who underwent (SICS) Small incision cataract surgery, intraoperative complications like poor pupillary dilatation, posterior capsular rent, zonular dialysis are noticed more in fan type of zonules followed by granular and winding type of zonules.

In a study by Mohammad Jawad et al, on complications Of Cataract Surgery in Patients with Pseudoexfoliation Syndrome, Concluded that Patients with pseudo exfoliation are at increased risk for development of complications.

Intraoperative complications are managed by appropriate measures. .In case of poor pupillary dilatation, surgeries like multiple sphincterotomy, intracameral pharmacological dilators or pupil stretching mechanical devices can be utilized.

Capsulorhexis should be done cautiously. Hydrodissection, nucleus and cortex removal should be done with utmost care.

Patient with significant zonular instability capsular tension ring can be used. It prevents intraoperative capsular separation, capsular rupture and improves IOL centration.

CONCLUSION

This study concluded that preoperative zonular characteristics by Ultrasound biomicroscopy showed statistically significant incidence of intraoperative complications in fan type of zonules when compared to granular and winding type of zonules. Hence in patients with pseudo exfoliative syndrome before undergoing cataract surgery UBM assessment is essential to identify different zonular patterns. This helps in prediction of operative complications earlier and necessary precautions can be taken to improve the visual outcome.

PART III

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ABBREVIATIONS

SLE – SLIT LAMP EXAMINATION

PXF – PSEUDO EXFOLIATION

UBM – ULTRA SOUND BIOMICROSCOPY

PSCC – POSTERIOR SUB CAPSULAR CATARACT

PC RENT – POSTERIOR CAPSULAR RENT

SICS – SMALL INCISION CATARACT SURGERY

CTR – CAPSULAR TENSION RING

MASTER CHART

S.No	NAME	AGE	SEX	UCVA	SLE -PXF	UBM
1	SAPRAM	68	MALE	6\36	BILATERAL	GRANULAR
2	NAGURKANI	63	MALE	6\60	BILATERAL	WINDING
3	PERIAYAKARUPAN	70	MALE	5\60	BILATERAL	GRANULAR
4	PAPATHI	65	FEMALE	6\60	UNILATERAL	GRANULAR
5	LAKSHMI	65	FEMALE	6\24	BILATERAL	FAN TYPE
6	ARATCHIAMMAN	60	FEMALE	6\60	BILATERAL	GRANULAR
7	SEETHALAKSMI	55	FEMALE	6\24	BILATERAL	GRANULAR
8	DANAM	70	FEMALE	5\60	UNILATERAL	GRANULAR
9	UKRAPANDYA	68	MALE	6\36	UNILATERAL	GRANULAR
10	MANDHYAN	65	MALE	6\60	UNILATERAL	FAN TYPE
11	KRITHANIAMMAL	75	FEMALE	5\60	BILATERAL	GRANULAR
12	ADAIKALAM	70	MALE	6\60	BILATERAL	WINDING
13	SRINIVASAN	72	MALE	6\24	BILATERAL	GRANULAR
14	PALRAJ	71	MALE	6\36	BILATERAL	GRANULAR
15	OCHAMMAL	60	FEMALE	6\36	BILATERAL	FAN TYPE
16	PALANISWAMY	65	MALE	6\24	UNILATERAL	GRANULAR
17	MARIAMMAL	70	FEMALE	5\60	UNILATERAL	GRANULAR
18	ARUMUGAM	60	MALE	6\36	UNILATERAL	GRANULAR
19	KURUVAN	60	MALE	6\60	BILATERAL	GRANULAR
20	PONNIS	63	FEMALE	6\36	BILATERAL	GRANULAR
21	POTHULINGAM	67	MALE	6\24	BILATERAL	GRANULAR
22	SANTHI	58	FEMALE	6\36	BILATERAL	GRANULAR
23	VALARMATHI	50	FEMALE	6\36	BILATERAL	GRANULAR
24	AYYAPAN	65	MALE	6\60	BILATERAL	GRANULAR
25	DEVARAJ	60	MALE	5\60	UNILATERAL	FAN TYPE
26	LAKSHMI	61	FEMALE	6\60	BILATERAL	GRANULAR
27	KARUPAI	62	FEMALE	6\24	BILATERAL	GRANULAR
28	KARUTHAMMAL	66	FEMALE	5\60	UNILATERAL	FAN TYPE
29	KANDASWAMY	67	MALE	6\36	UNILATERAL	GRANULAR
30	KARUPPAN	65	MALE	6\60	UNILATERAL	FAN TYPE
31	RAKKAI	63	FEMALE	5\60	BILATERAL	GRANULAR
32	MUTHUSWAMY	62	MALE	6\60	BILATERAL	WINDING
33	MUKKAN	61	MALE	6\24	BILATERAL	GRANULAR
34	MUTHAIYYA	67	MALE	6\36	BILATERAL	GRANULAR
35	SARATHA	72	FEMALE	6\36	BILATERAL	FAN TYPE
36	RAMASWAMY	71	MALE	6\24	UNILATERAL	GRANULAR
37	PANJAMMAL	70	FEMALE	5\60	UNILATERAL	GRANULAR
38	NOOR MOHAMMED	67	MALE	6\36	UNILATERAL	GRANULAR

39	NAGARAJ	66	MALE	6\60	BILATERAL	GRANULAR
40	MUTHULAKSHMI	65	FEMALE	6\36	BILATERAL	FAN TYPE
41	PICHHAI	64	MALE	6\24	BILATERAL	GRANULAR
42	MARIAMMAL	63	FEMALE	6\36	BILATERAL	GRANULAR
43	VALLIAMMAL	63	FEMALE	6\36	BILATERAL	GRANULAR
44	RAKKAPPAN	61	MALE	6\60	BILATERAL	GRANULAR
45	LINGAM	62	MALE	5\60	BILATERAL	GRANULAR
46	VELAYEE	69	FEMALE	6\60	UNILATERAL	FAN TYPE
47	SRUTHI	68	FEMALE	6\24	BILATERAL	FAN TYPE
48	RAMANATHAN	67	MALE	6\36	BILATERAL	GRANULAR
49	VELVIZHI	64	FEMALE	6\36	BILATERAL	FAN TYPE
50	CHELLAPPA	66	MALE	6\60	BILATERAL	GRANULAR

S.No	NAME	PUPILLARY SIZE AFTER DILATATION	LENS GRADING	SURGERY
1	SAPRAM	8	GRADE 2	SICS
2	NAGURKANI	6	GRADE 3	SICS
3	PERIAYAKARUPAN	7	GRADE 3-PSCC	SICS
4	PAPATHI	5	GRADE 2-PSCC	SICS WITH MULTIPLE SPHINCTEROTOMY
5	LAKSHMI	6	GRADE 2	SICS
6	ARATCHIAMMAN	7	GRADE 2 - PSCC	SICS
7	SEETHALAKSMI	7	GRADE 2	SICS
8	DANAM	5	GRADE 3-PSCC	SICS WITH MULTIPLE SPHINCTEROTOMY
9	UKRAPANDYA	7	GRADE 2	SICS
10	MANDHYAN	5	GRADE 3-PSCC	SICS WITH MULTIPLE SPHINCTEROTOMY
11	KRITHANIAMMAL	7	GRADE 2-PSCC	SICS
12	ADAIKALAM	7	GRADE 3-PSCC	SICS
13	SRINIVASAN	8	GRADE 2	SICS
14	PALRAJ	5	GRADE 3	SICS WITH MULTIPLE SPHINCTEROTOMY
15	OCHAMMAL	6	GRADE 2-PSCC	SICS
16	PALANISWAMY	6	GRADE 2	SICS
17	MARIAMMAL	6	GRADE 3	SICS
18	ARUMUGAM	7	GRADE 2	SICS
19	KURUVAN	7	GRADE 3	SICS
20	PONNIS	5	GRADE 3	SICS WITH MULTIPLE SPHINCTEROTOMY
21	POTHULINGAM	8	GRADE 2	SICS
22	SANTHI	7	GRADE 2	SICS
23	VALARMATHI	7	GRADE 2	SICS
24	AYYAPAN	6	GRADE 3	SICS
25	DEVARAJ	6	GRADE 2-PSCC	SICS

26	LAKSHMI	8	GRADE 2 - PSCC	SICS
27	KARUPAI	7	GRADE 2	SICS
28	KARUTHAMMAL	5	GRADE 3-PSCC	SICS WITH MULTIPLE SPHINCTEROTOMY
29	KANDASWAMY	7	GRADE 2	SICS
30	KARUPPAN	6	GRADE 3-PSCC	SICS WITH SFIOL
31	RAKKAI	6	GRADE 3	SICS
32	MUTHUSWAMY	6	GRADE 2-PSCC	SICS
33	MUKKAN	7	GRADE 2	SICS
34	MUTHAIYYA	5	GRADE 3	SICS WITH MULTIPLE SPHINCTEROTOMY
35	SARATHA	5	GRADE 2-PSCC	SICS WITH MULTIPLE SPHINCTEROTOMY
36	RAMASWAMY	7	GRADE 2	SICS
37	PANJAMMAL	6	GRADE 3	SICS
38	NOOR MOHAMMED	8	GRADE 2	SICS
39	NAGARAJ	7	GRADE 3	SICS
40	MUTHULAKSHMI	5	GRADE 3	SICS WITH MULTIPLE SPHINCTEROTOMY
41	PICHHAI	8	GRADE 2	SICS
42	MARIAMMAL	8	GRADE 2	SICS
43	VALLIAMMAL	7	GRADE 2	SICS
44	RAKKAPPAN	7	GRADE 3	SICS
45	LINGAM	7	GRADE 3-PSCC	SICS
46	VELAYEE	5	GRADE 2-PSCC	SICS WITH MULTIPLE SPHINCTEROTOMY
47	SRUTHI	6	GRADE 2	SICS
48	RAMANATHAN	5	GRADE 3	SICS WITH MULTIPLE SPHINCTEROTOMY
49	VELVIZHI	6	GRADE 2-PSCC	SICS
50	CHELLAPPA	7	GRADE 3	SICS

S.No	NAME	OPERATIVE COMPLICATIONS	CTR / CTS	POST OP VISION
1	SAPRAM	NILL	NILL	6\9
2	NAGURKANI	NILL	NILL	6\9 PARTIAL
3	PERIAYAKARUPAN	PC RENT	NILL	6\12
4	PAPATHI	ZONULAR DIALYSIS	YES	6\12 PARTIAL
5	LAKSHMI	PC RENT	NILL	6\9 PARTIAL
6	ARATCHIAMMAN	NILL	NILL	6\9
7	SEETHALAKSMI	NILL	NILL	6\6
8	DANAM	NILL	NILL	6\12
9	UKRAPANDYA	PC RENT	NILL	6\9

10	MANDHYAN	PC RENT	NILL	6\9
11	KRITHANIAMMAL	ZONULAR DIALYSIS	YES	6\12
12	ADAIKALAM	PC RENT	NILL	6\12
13	SRINIVASAN	NILL	NILL	6\6
14	PALRAJ	NILL	NILL	6\9
15	OCHAMMAL	ZONULAR DIALYSIS	YES	6\6
16	PALANISWAMY	NILL	NILL	6\6 PARTIAL
17	MARIAMMAL	ZONULAR DIALYSIS	YES	6\9
18	ARUMUGAM	NILL	NILL	6\9
19	KURUVAN	NILL	NILL	6\9
20	PONNIS	NILL	NILL	6\9
21	POTHULINGAM	NILL	NILL	6\9
22	SANTHI	NILL	NILL	6\6
23	VALARMATHI	NILL	NILL	6\9
24	AYYAPAN	PC RENT	NILL	6\6
25	DEVARAJ	PC RENT	NILL	6\9
26	LAKSHMI	NILL	NILL	6\9
27	KARUPAI	NILL	NILL	6\6
28	KARUTHAMMAL	ZONULAR DIALYSIS	YES	6\12
29	KANDASWAMY	NILL	NILL	6\9
30	KARUPPAN	ZONULAR DIALYSIS	NILL	6\9
31	RAKKAI	ZONULAR DIALYSIS	YES	6\12
32	MUTHUSWAMY	NILL	NILL	6\12
33	MUKKAN	NILL	NILL	6\6
34	MUTHAIYYA	NILL	NILL	6\9
35	SARATHA	PC RENT	NILL	6\6
36	RAMASWAMY	NILL	NILL	6\6 PARTIAL
37	PANJAMMAL	NILL	NILL	6\9
38	NOOR MOHAMMED	NILL	NILL	6\9
39	NAGARAJ	NILL	NILL	6\9
40	MUTHULAKSHMI	ZONULAR DIALYSIS	YES	6\9
41	PICHHAI	NILL	NILL	6\9
42	MARIAMMAL	NILL	NILL	6\6
43	VALLIAMMAL	NILL	NILL	6\9
44	RAKKAPPAN	NILL	NILL	6\9 PARTIAL
45	LINGAM	PC RENT	NILL	6\12
46	VELAYEE	NILL	NILL	6\12 PARTIAL
47	SRUTHI	NILL	NILL	6\9 PARTIAL
48	RAMANATHAN	NILL	NILL	6\9
49	VELVIZHI	NILL	NILL	6\6
50	CHELLAPPA	NILL	NILL	6\6

KEY TO MASTER CHART

UCVA – UNCORRECTED VISUAL ACUITY

SLE – SLIT LAMP EXAMINATION

PXF – PSEUDO EXFOLIATION

UBM – ULTRA SOUND BIOMICROSCOPY

PSCC – POSTERIOR SUB CAPSULAR CATSRACT

PC RENT – POSTERIOR CAPSULAR RENT

SICS – SMALL INCISION CATARACT SURGERY

CTR – CAPSULAR TENSION RING

POST OP – POST OPERATIVE

PROFORMA

NAME		
AGE		
SEX		
OCCUPATION		
IP/OP NUMBER		
PRESENT COMPLAINTS		
PREVIOUS MEDICAL / SURGICAL HISTORY		
ON SLIT LAMP EXAMINATION		
	RIGHT EYE	**LEFT EYE**
LIDS		
CONJUNCTIVA		
CORNEA		
ANTERIOR CHAMBER		
IRIS		
PUPIL		
LENS		

	RIGHT EYE	LEFT EYE
VISUAL ACUITY		
IOP by AT		
FIELDS		
COLOUR VISION		
DILATED SLITLAMP EXAMINATION		
Pupillary Diameter		
Lens Grading		
FUNDUS		
RETINOSCOPIC REFRACTION		
SUBJECTIVE VISION		
A SCAN		
Mean Axial Length		
KERATOMETRY		
KI		
K2		
IOL POWER		
DUCT PATENCY		

UBM		
Granular Type		
Winding Type		
Fan Shaped Type		
SICS		
Intraoperative Complication / Type		
Nil Complication		
POST OPERATIVE VISUAL ACUITY		

MADURAI MEDICAL COLLEGE
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ETHICS COMMITTEE CERTIFICATE

Name of the Candidate	:	Dr. Sangeetha.S.
Course	:	PG in MS., Ophthalmology
Period of Study	:	**2015-2018**
College	:	**MADURAI MEDICAL COLLEGE**
Research Topic	:	Role of zonular assessment by UBM before cataract surgery in pseudoexfoliation syndrome towards ensuring satisfactory PCIOL implantation.
Ethical Committee as on	:	21.04.2017

The Ethics Committee, Madurai Medical College has decided to inform that your Research proposal is accepted.

Member Secretary Chairman Dean / Convenor

Prof Dr V Nagaraajan
M.D., MNAMS, D.M., Dsc.,(Neuro), Dsc (Hon)
CHAIRMAN
IEC - Madurai Medical College
Madurai

DEAN
Madurai Medical College
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Student message: ROLE OF ZONULAR ASSESSMENT BY ULTRASOUND BIOMICROSCOPY BEFORE CATRACT SURGERY IN PSEUDOEXFOLIATION SYNDROME TOWARDS ENSURING SATISFACTORY PCIOL IMPLANTATION

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